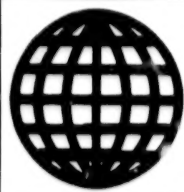


JPRS-UEQ-92-013  
31 December 1992



**FOREIGN  
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# ***JPRS Report***

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# **Science & Technology**

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***Central Eurasia:  
Engineering & Equipment***

# Science & Technology

## Central Eurasia: Engineering & Equipment

JPRS-UEQ-92-013

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31 December 1992

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# Sonar Data Transmission Line of Deep-Water Towed Vehicle

937F0011A Moscow OKEANOLOGIYA in Russian  
Vol 32 No 4, Jul-Aug 92 pp 774-775

[Article by N.A. Rimskiy-Korsakov, V.A. Sychev, Oceanology Institute imeni P.P. Shirshov at Russia's Academy of Sciences, Moscow; UDC 551.466.083]

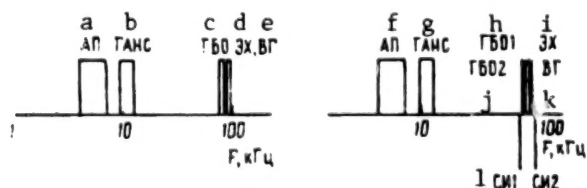
[Text] A multichannel system for transmitting sonar data over a coaxial cable using tuned audio frequency receivers in combination with standard narrow-band coupled electromechanical filters is described.

A series of deep-water towed "Zvuk" vehicles (GPA) was developed at the Oceanology Institute imeni P.P. Shirshov. They carry the following devices for a mesoscale geomorphological examination of the bottom surface: a two-channel side-looking sonar (GBO), an acoustic profile recorder (AP), and an echo sounder (EKh). In order to ensure the GPA movement safety at a distance of 10-80 m from the bottom, a forward ranging sonar (VG) is used while the GBA is coordinated over a hydroacoustic underwater navigation system (GANS) using a GBA receiving hydrophone (PGF).

The left figure shows a working frequency alignment chart of the aforesaid GBA sonar equipment (GLA) where one can see that it is possible to relay the GLA echo signals on board the carrier vessel (SN) at the operating frequency only by using a multiple conductor cable. Yet in order to tow the GBA and decrease the diameter and cable drag, tow lines with a single coaxial pair of conductors are used as a rule. The use of coaxial tow cables as part of the GBA systems equipped with television equipment is especially relevant.

One of the methods of solving the problem of relaying the echo signals over the coaxial communication line is to use GLA devices with separated working frequencies. Yet this method complicates standardization of the acoustic antenna designs of such GLA devices as the GBO, EKh, VG, AP, and PGF and makes it difficult to reduce their cost.

Another possible way of separating the echo signals in the coaxial line is to convert the echo signal frequencies



Frequency Distribution Alignment Charts: on left—GBA sonar equipment; on right—sonar equipment signals present simultaneously in the Zvuk GBA coaxial communication link

key: a. AP; b. GANS; c. GBO; d. EK; e. VG; f. AP; g. GANS; h. GBO1; i. EK; j. GBO2; k. VG; l. sync pulses (SI); frequency in kHz

in the receiving sections of the vehicle and ship sections of the GLA. Thus, e.g., vehicular and ship modules of the receiving sections in the Oceanology Institute equipment considered in [1,2] contain facilities for performing frequency conversions executed using LC-elements. Yet this design has a number of significant shortcomings, namely: a) it is difficult to check and tune the GLA during operation; b) the electronic circuits are complicated and, consequently, rather unreliable; c) the sections have a narrow dynamic range; and d) the input sensitivity is low (10  $\mu$ V).

In the recent GBO developments performed at the Oceanology Institute, the task of relaying the GLA echo signals was successfully solved by using tuned audio frequency receivers in combination with standard coupled electromechanical filters R2141159-(1-12). These filters form a comb of 12 frequency channels within a 62-108 kHz range which lies within the frequency band of the GBO, EKh, and VG with a bandwidth of  $\Delta f = 3.2$  kHz and a maximum attenuation level of  $\beta = -60$  dB. We should note that the filter response can be successfully matched with the requirements imposed on them with respect to the sonar data transmission system. The figure on the right shows a frequency distribution alignment chart of the GLA signals simultaneously present in the coaxial communication link. GLA antennas are excited at frequencies close to resonance frequencies within the antenna bandwidth which coincide with the working frequencies of adjacent electromechanical filters in the standard series.

The above design made it possible to use identical acoustic antennas for the left and right GBO channels as well as for EKh and VG. The tuned audio frequency channel designs developed for this purpose were used for relaying the GBO, EKh, VG, and AP echo signals over the coaxial transmission line and the GANS signals as well as for transmitting the ship timing signals on-board the GBA.

Thus, this experimental study resulted in developing a system for transmitting sonar data over a coaxial communication link which is characterized by using standardized frequency channels on the basis of electromechanical filters whose characteristics are quite consistent with the outputs of GLA onboard receiving amplifiers. Full-scale tests and pilot operation demonstrate that GLA with the above characteristics ensure the following: a) a GBO sounding range on each side of up to 1000 m; b) a frontal GBO resolution of  $0.01 L$  where  $L$  is the distance to the object; c) a GBO range resolution of 80 cm; d) an EKh and VG operating range of up to 400 m; e) a maximum EKh and VG distance measuring error of 0.4 m; f) an EKh maximum front resolution of  $0.09 H$  where  $H$  is the distance; g) a maximum sediment sounding depth of 60 m; and h) a maximum GPA coordination error within a  $2 \times 2$  km testing range at a 5000 m depth of 20 m.



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### New Type Nuclear Reactor Planned for 1997

LD2011133792 Moscow ITAR-TASS in English  
1254 GMT 20 Nov 92

[By ITAR-TASS correspondent Veronika Romanenkova]

[Text] Moscow, November 20 (TASS)—Specialists from the research and design institute of energy-generating technologies have developed a new generation of the MKER-800 nuclear reactor. The new nuclear reactors will probably replace the reactors of the "Chernobyl type" (RBMK) at the Leningrad, Kursk and Smolensk nuclear power plants, which will begin to be put out of service in 10 to 15 years. The design was presented today at the Russian-Norwegian seminar on the safety of complex technical systems.

By the time the service life of the RBMK reactors is over, they will be replaced by more up-to-date and safe installations. The design presented today is good, but it is not the only one, a spokesman for the Russian Ministry of Nuclear Power Engineering told ITAR-TASS. The ministry's officials believe that the main obstacle is the negative attitude of the public to nuclear power engineering in general, and one should take public opinion into account.

The MKER reactor with the capacity of 800 megawatt is a new generation of channel reactors of the boiling type. The authors of the design maintain the reactor is absolutely safe. The overcoming of the emergency situation, should it occur, is ensured with the help of so-called passive means, the action of which is based on the physical laws of nature, and the interference of man is ruled out.

The new reactor is unique for one more reason: it is the only one among the reactors, which is fitted with devices for obtaining a wide range of isotopes, used in medicine, scientific research and technology, and for the radiation modification of the characteristics of materials.

Specialists believe the development of the working design may be completed before 1997. They plan to build the first power unit and put it into operation at the Leningrad Nuclear Power Plant between 1997 and 2003.

### Danger of RBMK Reactors Explored

927F0335D Moscow SPASENIYE in Russian  
No 31-32(46-47), Aug 92 pp 6

[Article by Yuriy Gvozdev, Columnist: "Chernobyl-2 Coming?"]

[Text] Publication of an article by Stewart Boyle, Director of the Energy Department of Greenpeace International, is expected in the August 1992 issue of the British magazine *Energy Policy*. Its title speaks for itself: "Soviet High-Power Pressure-Tube Reactors—Outlook for the Future". We're talking about the design which

caused the Chernobyl catastrophe. It was also responsible for an emergency at the nuclear power plant (AES) located in the vicinity of St. Petersburg (in Sosnovy Bor in April of this year). In the author's opinion, it is necessary to shut down all 16 RBMK reactors operating today in the territory of the former U.S.S.R. and replace them with similar PWR or CANDU reactors or non-nuclear plants, including gas turbines, etc.

This Greenpeace viewpoint was confirmed with even greater determination in the course of a "roundtable" of power engineering experts in Moscow. The meeting was organized by the Committee on Industrial and Energy Policy at the Supreme Council of the Russian Federation. Speaking after its conclusion, the aforementioned Stewart Boyle positively assessed the results. In particular, he expressed his satisfaction that the Deputy Chairman of the Industry and Power Engineering Committee Gennadiy Kalistratov agreed with Greenpeace's opinion and thinks that it is possible to shut down the RBMK reactors in the "near future". Moreover, he also thinks that this is "feasible from the technical and economic viewpoints".

At the same time, John Willis, a conference participant and a coordinator of the Greenpeace anti-nuclear campaign added his viewpoint: "Despite the opinion shared by the Russian and Western experts that the RBMK reactors are too dangerous for continuing their operation, the principal force of the nuclear experts from the ministry of atomic energy continue to insist that this reactor design be maintained". At the same time, the coordinator referred to a presidential advisor on ecology, to the Russian Federation Ministry of the Environment, and to independent experts in Moscow who, in his words, share the Greenpeace stand on this issue. In this, Willis saw an "important turning point in Russian policy".

During a press conference with Greenpeace representatives, Sergey Yermakov, Director of the Press Center at the Russian Federation Ministry of Atomic Energy, clarified Gennadiy Kalistratov's position. In his words, Kalistratov did not categorically endorse the opinion of the "Greens" regarding the nuclear power industry. Yermakov was critical to the principle and very system of Greenpeace arguments. Thus, in his opinion it would be reasonable to demand, e.g., that hydroelectric power plants be destroyed and justify this by the need to restore the planting areas. Or to give up using gas by referring to the accidents which happen in gas main lines. He also mentioned that in the past, the International Atomic Energy Agency (MAGATE) highly evaluated the RBMK reactor safety degree: in this, they competed with the best Western analogues. Or, he asked a question, would it be better to switch to firewood using Greenpeace criteria? But how would one then satisfy the demands of the economy in energy and daily needs of millions of people? Or should we go back to the candle and kindling wood? In his opinion, the following doubt arises in this

case: are we talking about an attempt to discredit Soviet reactor engineering based on the selfish competitive interests of the West?

In my opinion, the argument around the fate of the RBMK reactors is a central one. And it seems, the situation is not limited to these reactors: some time ago, the *Financial Times* of London published an article entitled "The Eastern Threat" where all reactors manufactured in the former U.S.S.R. and installed in Eastern European countries were severely criticized. Even though it cited such positive technological evaluations on the part of individual IAEA experts, the article mentioned that "the Soviets have 16 RBMK reactors... and as a result of extensive overhauls carried out since 1986, they have partially relaxed Western concerns about their safety". The same article also stated that such companies as the German Siemens and the French Framatom are prepared to replace the RBMK reactors in Eastern Europe with their own products while Romania, in particular, was offered the CANDU reactors designed in Canada... Yet in my opinion, it would be premature to speak about any almost absolute reliability of Western NPP equipment. Thus, more than 30 serious "malfunctions" with nuclear reactors occurred at the Savannah River complex in the United States between 1957 and 1985. So, what is the solution?

In my opinion, we should calmly, dispassionately, and comprehensively approach the issue of today's power engineering without clumsily assailing the vital interests of the population and the national pride and right for development characterizing every nation.

Yet something else is clear: life calls upon us to take all possible safety measures so as to prevent such catastrophes as Chernobyl. Hence one can understand the concern expressed by the Greenpeace movements about the RBMK reactors. Hence, the anti-nuclear sentiments of the world community are easy to explain.

With respect to the foregoing, I would like to remind you about a movie by the Japanese producer Akira Kurosawa called "Dreams". A boy from the Land of the Rising Sun has a dream about NPP explosions. It is called "Red Fujiyama". A menacing scarlet color engulfs the entire terrain while the color of the smoke depends on the content of radioactive metals in it: red means uranium, green means cesium, blue means strontium. Everything around is contaminated with radioactivity. The people are doomed. Some are burned alive, others are stricken by incurable cancer diseases. As it turns out, an engineer who could not manage such technological monsters as NPPs is responsible for the catastrophe. He commits suicide and jumps into the sea from a rock... Is it a continuation of tragedy related to the Chernobyl RBMK reactor? Yet this time due to the fault of its "more perfect" Japanese, American, or French analogue?

One way or another, we necessarily arrive at the conclusion. Urgent measures are necessary to find efficient

alternative energy sources the demand for which will inevitably increase henceforth and everywhere including the CIS and the countries of the North, East, and South. Yet these sources must be environmentally clean and safe for human health. There are certain developments in various directions. There are first successes yet we should move ahead more decisively.

Let's look at the Maritime Region for example. Japan offered the former U.S.S.R. assistance in building there an NPP in exchange for subsequent shipment of energy to the Land of the Rising Sun. Yet the domestic scientists had a different solution to the problem. I familiarize myself with the work of one of them at the Environmental Invention Fund (FEI). Its author is Gleb Predtechenskiy, an engineer from the Shikotan Island. In his opinion, it is possible to position several groups of wind power plants along the Lesser Kuril Ridge. This would utilize the territory of completely flat islands with an area of 100 km<sup>2</sup> located along the path of seasonal winds and cyclones. Such a powerful energy complex would be commensurate in its energy potential with an NPP and would be capable of supplying the needs of not only the local population but also the island of Hokkaido (Japan).

Maybe by rejecting national self interest and primitive commercial greed we can set up an international scientific and technical agency for the development and implementation of alternative sources of energy? Maybe we should think about developing peculiar international testing ranges for trying out and developing power plants utilizing such nonconventional energy? And spend for these purposes a proportion of resources which until recently have been spent for the arms race (and are still being spent).

There are many questions. The concern expressed by the Greenpeace and all thinking mankind is justified. We should make sure that all our planet becomes nuclear-free. Yet we should proceed along this path together without any unilateral advantage.

## Conditions, Problems to Overcome at Chernobyl

### Chernobyl AES Today

937F0050a Kiev VISNYK AKADEMIYI NAUK  
UKRAYINY in Ukrainian No 9, 92 pp 17-20

[Report at the May 8 meeting of the AN Ukrayiny [Academy of Sciences of Ukraine] Presidium by AN Ukrayiny Academician V. Bakhtaryar under the "Articles and Reviews" rubric]

[Text] The ChAES [Chernobyl AES] today is a complex consisting of three units RBMK-1000 and facility "Shelter" (the destroyed 4th unit). Facility "Shelter" was already a subject at a meeting of the AN Ukrayiny Presidium. I shall remind you of the main data. At present it contains approximately 135 +/- 35 tonnes of radioactive fuel. Its activity is approximately 20 MCi of

medium- and long-life radionuclides. All this radioactivity is in an unorganized (chaotic) state.

Facility "Shelter" was built under the most difficult conditions between July and October of 1986. During this period, designers and builders demonstrated exceptional professionalism, and those who participated in the construction and had to work in high-intensity radiation fields demonstrated a high level of organization of work and great personal courage. In the 6 years since the accident the "Shelter" has been and still fully performs its function of protecting the environment from the ingress of radioactive elements. However, during this period it has aged, and it turned out that the pace of its aging is higher than was anticipated (but then this is true for everything that is alive in the Chernobyl zone). In other words the "Shelter" needs reconstruction, and radioactive materials inside it need recycling.

In order to solve scientific problems related to these tasks, an Interbranch S&T Center (ISTC) has been created under the AN Ukrayiny auspices. The Center is called upon to convert the "Shelter" into a durable ecologically safe system, ensure nuclear and radiation safety of the facility, develop robotic equipment and radiation technologies for taking samples and extracting from facility "Shelter" and storing nuclear fuel and radioactive materials, control and forecast changes of properties of substances contained in nuclear fuel, changes in the condition of the facility materials and structures and ecological safety in the zone of its influence, and attract state-of-the-art domestic and foreign technology for solving the ISTC tasks.

The Center is located directly in the town of Chernobyl and maintains operative contacts with a number of our and not only our (Moscow and St. Petersburg) institutes involved in liquidation of the consequences of the catastrophe.

I propose, by a ruling of our Academy Presidium, to charge the ISTC with performing S&T examination of work on decommissioning the ChAES.

Taking into account the scope of destruction and understanding its responsibility to the world community for liquidation of the consequences of the Chernobyl catastrophe the Cabinet of Ministers of Ukraine has adopted the proposal of the Academy of Sciences and Minchornobyl Ukrayiny [expansion not given] to conduct an international competition for a project and technical decisions for converting facility "Shelter" into an ecologically safe system. The objective of the competition is to choose the optimum solution of the problem while enlisting domestic and foreign specialists, organizations and enterprises that have state-of-the-art S&T potential.

Let us go back to power generating units No 1 (1977), 2 (1978) and 3 (1981). I shall remind you that in the summer of 1986 the Academy of Sciences of Ukraine sent a letter to the Government Commission with a suggestion not to put the ChAES into operation but rather begin dismantling it. It is well known that the

Commission turned down the suggestion. So after the accident the Chernobyl power plant again began operation. In the last 4 years it produced 5.5% of the total amount of electrical power generated in Ukraine.

The heart of the power generating unit is a single-loop uranium-graphite reactor. Power is generated in fuel cells (FCs) and extracted from them using water and steam flow. The water and steam flow in zirconium pipes inside and stainless steel pipes outside the reactor. There is a special system for continuous control of the condition of the pipes and a standard technology for replacing them in case of failure. The volume of water flowing in the pipes is controlled by means of multipurpose [shutoff and actuator] valves (MPVs). One can only control the condition of the valves when the reactor is shut off. Each Chernobyl reactor has 1661 such valves, one for each FC.

Each reactor contains approximately 200 tons of uranium fuel. Its activity is close to  $10^9$  Ci. I shall remind you that 20 million Ci was discharged from the 4th unit reactor.

Each reactor room in the ChAES has retention ponds where spent fuel cells are placed. According to the standard technology, after being kept there for one and a half to two years the fuel is removed from there to spent nuclear fuel storage sites (SNFSSs). At present the total amount of active and spent nuclear fuel—FCs—at the station is as follows: 4743 FCs (approximately 600 tons) at the station, 2058 FCs (approximately 240 tons) in retention ponds and 11,131 FCs (approximately 1300 tons) in storage sites.

The total capacity of storage sites is 17,520 FCs. Therefore, in order to place the spent nuclear fuel that has been accumulated up until now the storage sites will have to accept 410 FCs above the capacity.

Provided that the 1st and 3rd power generating units are in operation, the number of FCs with spent nuclear fuel will increase by the end of 1993 by another 1000 pieces, and the storage sites will have to accept up to 1500 more pieces above the capacity. The existing storage sites do not meet the requirements of new safety rules and standards, therefore the project stipulates construction (tentatively by 1998) of a new storage site using the new "dry storage" technology. In it spent nuclear fuel will be stored for 40 years. And the technology of container fuel packaging provides for its unlimited storage. In other words, after the 40 years one will be able to move the containers to a regional storage site.

According to plans of the former Union an FC processing plant was supposed to be built by the year 2000. It is clear now that such a plant will not be built on time and that it will be necessary to do serious work on building in Ukraine a permanent storage site for spent nuclear fuel or a plant for processing it.

Last but not least, a reminder from a high school physics course. Shutting off a reactor, i.e. a chain reaction, does



not at all mean stopping spontaneous nuclear disintegration (this fact is not being taken into account in the meetings). This disintegration causes intensive release of energy which, if a reactor is left without water cooling, is quite sufficient to melt FCs and discharge a huge amount of radioactivity into the environment.

During the power plant's operation 21,800 cubic meters of liquid radioactive waste has been accumulated. It is stored in tanks. When decommissioning the ChAES it is necessary to design and build equipment that makes it possible to convert liquid radioactive waste to solid state for further storage (bituminization, embedding in concrete or vitrification).

It should be noted that after the 1986 catastrophe all RBMK reactors were reworked and at present their safety has increased substantially—by a factor of several dozens and even hundreds.

At present (early May - editor's note) <sup>2</sup> three reactors have been shut off. The second unit was shut off because of the fire on October 11, 1991. The first unit was shut off on March 1, 1992, for a planned 85-day repair. The third unit reactor was shut off on April 11 for preventive maintenance (since the shutoff bottoms of these reactors have already melt down).

On March 24 a radiation incident occurred at the Leningrad ChAES, which like the ChAES uses RBMK-1000 reactors. A reactor was shut off by the emergency protection system. Investigation of the accident revealed that it had been caused by deterioration of FC cooling conditions in one of the 1600 technological channels because feeding of cooling water had been stopped due to an MPV defect.

The radiation incident at the LAES [Leningrad AES] has stimulated a more in-depth inspection of the 1st and 3rd Chernobyl power generating units. And what has it demonstrated? During their operating time multipurpose valves have been worn down, and serious defects were detected in a large number of them. This means that one cannot operate the reactors without replacing MPVs, because this will result in radiation incidents or even in an accident.

So these new (after the fire of the 2nd power generating unit) circumstances force one to turn once more to the ChAES fate for the foreseeable future.

#### Option one.

As you well know, the Supreme Soviet of Ukraine made a decision to shut off the ChAES at the end of 1993 and begin its decommissioning in 1994. In the meantime a boiler house will be built. Together with the existing boiler house the new one will make it possible to supply necessary heat and steam to the power plant for maintaining it in a non-stressed (emergency) mode, when the temperature inside the premises will be between +5 and +10°C, and for processing of liquid radioactive waste. To

implement this option (operation of the 1st and 3rd units till the end of 1993) it will be necessary to replace over 3,000 valves in these units.

This work will take approximately 7 months and cost about R3 billion. Of course, the replacement of valves will involve certain Br [biological roentgen] outlays. Calculations performed by plant's management demonstrate that they will not exceed norms for professionals. Another complication is that the valves are manufactured at Russian plants. All this work must be completed before the winter cold.

An economic analysis performed by the ChAES management demonstrates that funds for the repairs can be procured by selling electrical power in 1993.

Another scenario requires the immediate shut-off of the plant, i.e. not to restart the 1st and 3rd units at all. Such decision will probably elicit certain positive response from the population. In this case one will not have to make and replace MPVs.

However, about R2.5 billion will be needed to perform urgent additional work on maintaining the plant and preparing it for the winter. Obviously, during the time before the winter spontaneous reactivity in the reactors will decrease to such a level that there will be no threat of reactor pipes meltdown. However, the plant will still need heat, electrical power, steam etc. in order to maintain it in a radiation- and technically safe condition.

Main drawbacks of this scenario are as follows:

- 1) there is neither a work project on decommissioning the plant nor technical standards documentation;
- 2) an urgent need to solve the problem of employment of the personnel;
- 3) ensuring nuclear and radiation safety under the conditions of complete unpreparedness of the plant for decommissioning;
- 4) specific people (in the government, Supreme Soviet and of course in the Derzhatomnaglyad Ukrayiny [expansion not given]) must take the responsibility for the decision to immediately shut off the plant.

I shall remind you that according to safety requirements a project for decommissioning a plant must be developed 5 years prior to its shutoff.

It is my opinion that the first scenario, wherein MVPs and FCs will be replaced and there will be a certain amount of time till the end of 1993 in order to get ready to begin the work, is more realistic.

The author is grateful to Messrs. M.P. Umanets, M.M. Sorokin and O.Ye. Yeshchenko for their help in preparing the report.



**Realities of Post-Chernobyl Era (Life and Housekeeping in Contaminated Territories)**

937F0050b Kiev VISNYK AKADEMIYI NAUK  
UKRAYINY in Ukrainian No 9, 1992 pp 21-26

[Article by Chairman of the AN Ukrayiny Council on Studying Productive Forces of Ukraine (Kiev) Doctor of Economic Sciences Professor Sergiy Ivanovych Doroguntsov and Manager of the above Council's Department for Problems of Development and Distribution of the Productive Potential Doctor of Economic Sciences Alina Mykytivna Fedoryshcheva]

[Excerpts] *The further we are from the Chernobyl tragedy the more perceptible its consequences become. Measures related to their liquidation have become an integral part of the entire post-Chernobyl life of Ukraine. Science and manufacturing are involved in their development and implementation, and because of these measures problems of culture and morality are being faced with special acuteness.*

By a decision of the Supreme Soviet, Ukraine has been pronounced the zone of national ecological catastrophe. Direct physical destruction of facilities of the fourth power generating unit of the Chernobyl AES is only a part (and not even the main part) of the damage to the entire complex in the April 26, 1986 accident. Among its consequences are catastrophic contamination and qualitative and structural deterioration of the biosphere, deterioration of the quality of life and health of the population, and genetic mutilations.

In this situation it is very important that all actions aimed at removing or at least reducing the danger are adequate to the current circumstances. And here a lot depends on precise scientific justification of the steps. However, it is equally important that one hears scientists' recommendations. In his interview on the eve of the fifth "black anniversary" the AN Ukrayiny President B.Ye. Paton reminded people that at the time the Academy resolutely objected to construction of the Chernobyl nuclear power plant. Later it objected to the evacuation of residents from the 30-km zone to adjacent allegedly "clean" regions. At that time the scientists' arguments were ignored. Neither did the government use the scientists' recommendations when millions of rubles were spent for building the town of Slavutych. The thing is, the Academy of Sciences (particularly based on the work of the Council on Studying Productive Forces of Ukraine) proposed to completely stop further operation of the ChAES.

Today the problem of eliminating the consequences of the Chernobyl accident includes a complex of issues (medical, ecological, socioeconomic and political) that call for immediate solutions. Repeated changes of criteria of radioactive contamination for places of immediate relocation, limited residence and limited business activity (in particular as far as consumable products and water are concerned) during the post-accident period have resulted in huge socioeconomic losses.

In August 1990 the government of Ukraine and Presidium of the Academy of Sciences commissioned the Council on Studying Productive Forces of Ukraine to prepare a scientific report "Settling the Population, Providing Rational Employment of Labor Resources and Efficient Utilization of the Production Potential of the Zone of Radioactive Contamination of the Chernobyl AES". The following organizations took part in the studies: the Derzhbud [State Committee for Construction] institutes - Dipromisto, UkrNDIPKtsyvililbud and Diprotsyvilprombud; the Academy of Sciences institutes - Geography, Sociological Studies, State and Law; the AMN [Academy of Medical Sciences] Radiation Medicine Science Center, Kiev Social Hygiene NDI [scientific research institute], the MOZ [Ministry of Health] Administration for Population Health Service, Ukrgeologiya, Ukrgidromet, Ukrainian Branch of the Agricultural Radiology Institute and Kiev National Economy Institute.

The scientific novelty of the work is integrated assessment of the zone of radioactive contamination and of ecological, economic and social losses caused by it, development of the concept and principles of resettlement of the zone residents, generalization of the experience of resettlement and territorial residence of the evacuees, support of the program of construction of housing for the resettlers and determination of territories for new settlement, as well as studies of demographic, medico-psychological and socioeconomic problems by collecting the population's questionnaires and certification of places of settlement, and development of the concept of life support and survival of people and employment of labor resources. Problems of development and efficient utilization of the production and scientific potential in radioactive contamination zones were worked on in a new way, a concept of carrying on agriculture was formulated, and legal problems of peoples' settlement were developed. In doing this, we took into account international aspects of mitigating the consequences of the accident. Lately all this has made it possible to assess the post-Chernobyl situation more comprehensively, from the position of reliable knowledge.

Materials of the scientific report had been used in preparing three Chernobyl-related laws that were approved by the Supreme Soviet of Ukraine: "On the Status and Social Protection of Citizens That Suffered as a Result of the Chernobyl Catastrophe", "On the Legal Regime of the Territory That Sustained Radioactive Contamination as a Result of the Chernobyl Catastrophe" and "On the Concept of Population Residence in the Ukrainian RSR [Soviet Socialist Republic] Territory With an Increased Level of Radioactive Contamination as a Result of the Chernobyl Catastrophe". Not only do these laws regulate the division of territories that suffered radionuclide contamination into appropriate zones, but they also ensure legal protection of the victims. Extremely important legal regulations have been approved.

It is well known that prior to the ChAES accident a no-threshold concept of radioactive exposure was accepted. In 1988 the Ministry of Health of Ukraine decided to consider as permissible a lifetime individual dose of 35 Br. This meant that it was permissible to live in a territory with the level of contamination of up to 15 Ci/sq. km. Results of studies presented in the Council's scientific report to the Cabinet of Ministers of Ukraine showed the unacceptability of such a concept. Having turned it down, Ukraine and Belarus adopted another concept according to which the dose (over the natural background) a person will be exposed to during his or her lifetime must not exceed 7 Br (or 0.1 Br per year). It is based on this limit that the above laws of Ukraine, which must provide social guaranties to all Chernobyl victims, were adopted.

The goal of the approved Concept regarding residence in territories with increased levels of radioactive contamination is to reduce the negative effect of radioactivity on the population's health. For making a decision on resettlement until such time when an effective individual equivalent dose for the population is established, the density of radionuclide contamination of soil has been accepted as a temporary criterion. The first stage is unconditional (mandatory) relocation from territories with the density of soil contamination with cesium isotopes is at least 15 Ci/sq. km and the density of soil contamination with plutonium isotopes is at least 0.1 Ci/sq. km. The second stage is guaranteed voluntary relocation from territories with the density of soil contamination with cesium isotopes between 5 and 15 Ci/sq. km (or between 0.15 and 3.0 Ci/sq. km for strontium or between 0.01 and 0.1 Ci/sq. km for plutonium). The decision on relocation is made taking into account additional criteria, such as the impossibility to guarantee production, processing and sales of clean food products.

Population residence in territories with the density of cesium isotope contamination of up to 5 Ci/sq. km (or up to 0.15 Ci/sq. km for strontium or 0.01 Ci/sq. km from plutonium) is permissible if there is increased radiological control that takes into account natural climate integrated ecological characteristic of the specific territory, provided the additional (taking into account the Chernobyl catastrophe) effective equivalent radiation dose does not exceed 0.1 Br per year. If this condition is not met the population is given the opportunity to relocate to radioecologically clean areas. This is a very important and legitimate approach. Its substantial positive element is additional payment to residents of territories with cesium isotope contamination between 1 and 5 Ci/sq. km, as well as compensation to enterprises, kolkhozs and forestries that have lost their physical assets as a result of the ChAES accident. [passage omitted]

Relocation of people from contaminated territories has caused a substantial change in distribution of population in the Kiev, Zhytomyr, Rivne, Chernigiv, Vinnitsa and Chernivtsi oblasts. The entire demographic situation has become aggravated.

In 1986-1989 intrarayon resettlement of residents from villages with a high contamination level (over 50 Ci/sq. km) was carried out. However, later it became clear that the number of villages with a high level of radioactivity was much higher. In 1990 the situation became even more complicated. On the one hand, the Concept stipulated relocation of all residents from contaminated areas, on the other, it included principles of preservation, as much as possible, of territorial, administrative, business and resettlement structures. Besides, it was found that certain families did not want to move to the villages they were offered. Neither was there coordination with the decree of the former Union government of 23 August 1990, which had stipulated transferring funds for residential construction for the resettlers to other areas at their request. The problem of resettler's employment and development of construction and recreation is another aspect of the program that has not been developed sufficiently. [passage omitted]

According to the National Program of Urgent Measures on Liquidation of the Consequences of the ChAES Accident and the Academy of Sciences of Ukraine Presidium resolution of 23 May 1990 the Council on Studying Productive Forces of Ukraine is studying the distribution and development of productive forces in territories that suffered radionuclide contamination. In preparing a scheme of development of productive forces one should keep in mind that the land in the zones of alienation and unconditional (mandatory) relocation is being taken out of business, separated by marked boundaries from adjacent territories and assigned to the dangerous land category.

In the zone of guaranteed voluntary relocation it is prohibited to build new and expand existing enterprises that are not related directly to ensuring radioecological and social protection of population and to conduct any activities that aggravate the radioecological situation.

The concept of development of the production potential in radioactive contamination territories stipulates development and implementation of efficient methods for decontamination of soil and bottom deposits in water reservoirs, as well as securing the land surface in order to prevent dust formation. One must implement measures aimed at renewal of the natural hydrobiological regime of water objects in the river of Prypyat basin. In the process it is necessary to prevent leakage of radioactive materials into water flows. Measures aimed at preventing vegetation fires and immediate extinguishing of vegetation fires that have broken out and at improving methods for decontamination of contaminated forest (it is well known that burial of "red forest" in the vicinity of railroad station Yanov became the source of secondary radioactive contamination of the environment) have been planned. It is necessary to conduct a more precise zoning of the territory and establish various modes of its utilization.

The problem of radioactive waste burial is urgent. However, we have so much of it that there is no sense talking

about its relocation. It is necessary to accelerate the development of the project of the plant known as the "Vector" project.

It is planned to provide efficient radiation control of food and potting and irrigation water (to which mineral sorbents must be added) and dosimetric control of each yard. In other words this is a long-term program of radiation monitoring of the environment in the contamination zone.

In order to ensure the most reasonable use of the production potential of the zone, a set of organizational, technical and business measures has been developed. The first-priority measures are as follows: switching industrial enterprises to manufacturing ecologically clean products; stopping any business activity in the radioecological catastrophe and disaster zone that would adversely affect the ecological situation; switching thermoelectric power plants located in the zone to gas; conducting regular independent ecological inspections of the Rivne nuclear power plant and broad discussion of the conclusions; immediate solution of the problem of additional construction of special burial places for waste generated during decontamination work related to ChAES maintenance; and development of NVO [scientific production association] "Prypyat" which has the right to be in charge of the nuclear inheritance of Chernobyl, this sort of nuclear laboratory.

It must be stated unequivocally that "liquidation of the consequences of the Chernobyl accident" is not possible at all. The prospect is for man and biosphere to adjust and adapt to the new irreversible post-Chernobyl stage. This is why, rather than having plans for liquidation, one needs comprehensive development of immediate and long-term programs of business activities under the conditions of residing in contaminated territories.

#### Two Truths About Chernobyl (From Documents of the CPSU Central Committee Politburo, 1986)

937F0050c Kiev VISNYK AKADEMIYI NAUK  
UKRAYINY in Ukrainian No 9, 92 pp 95-98

[Memos by an editor of the Science Department of PRAVDA V. Gubarev and by First Secretary of the Central Committee of the Communist Party of Ukraine V. Shcherbitskiy under the "Retrospective" rubric; first two paragraphs are the VISNYK AKADEMIYI NAUK UKRAYINY introduction]

[Text] Below we are publishing two documents sent to the CPSU Central Committee Politburo—a May 16, 1986, memo by an editor of the Science Department of PRAVDA V. Gubarev (it was attached to a secret decree of the CPSU Central Committee Politburo of 22 May 1986 "On the Progress of Liquidation of the Accident at the Chernobyl AES and Further Measures on Conducting This Work") and equally "absolutely secret" information by the First Secretary of the Central Committee of the Communist Party of Ukraine V. Shcherbitskiy "On Work That Has Been Conducted in Regard to the Accident at

the Chernobyl AES" which was sent to the Politburo a week later. The documents are being reprinted from the RODINA magazine (No 1, 1992 pp 85-87).

We will refrain from any commentaries. By comparing the two messages from the place of accident an attentive reader can himself or herself draw proper conclusions.

#### V. Gubarev: "A Panic Mood in Kiev..."

From May 4 to 9 (1986 - editor's note) I have been in the area of the Chernobyl AES. I consider it my duty to share some of my observations:

1. Evacuation of the town of Prypyat. After as little as one hour the radiation situation in the town was clear. No measures in case of an emergency situation had been planned - the people did not know what to do.

According to all instructions and orders, which have already existed for 25 years, the local leaders had to make the decision on removing the population from the dangerous zone. By the time the Government Commission arrived it was possible to get everybody out of the zone even by foot. But nobody took upon himself or herself the responsibility (the Swedes first transported people from the zone of their power plant and only then got to finding out that the discharge happened not at their plant).

2. Work in dangerous zones (including the area 800 m away from the reactor) was done by soldiers without individual protection gear, particularly when unloading lead. During a conversation it was ascertained that they did not have such gear. Helicopter pilots found themselves in the same situation.

And officers too, including marshals and generals, were uselessly making a show by appearing near the reactor in their regular uniforms. In this case it was necessary to display smartness rather than a twisted idea of courage.

3. Drivers during evacuation of the town of Prypyat and when working on banking up the river also worked without individual protection gear. The fact that the radiation dose was equal to the "annual norm" cannot be used as justification—these were mainly young men, hence this will affect their offspring.

In the same manner, the acceptance of "combat norms" for military units is a last resort measure in the case of combat action and when crossing a nuclear weapons casualty zone. In my opinion such order was given exactly because individual protection gear was not at the moment available; during the first stage of the accident only special units had it.

4. The entire civil defense system turned out to be completely paralyzed. It was not even possible to find dosimeters that were in working condition.

5. Fire fighting units had been working marvelously. They prevented expansion of the accident during the first stage. But even those units that are stationed in the



town of Prypyat did not have proper uniforms for working in an increased radiation zone.

6. The machine room roof was made of easily inflammable materials. The same materials had been used in the Bukhara weaving mill which burned down in the early 1970s. And although after the Bukhara accident certain employees were put on trial, the same materials were used in AES construction.

7. In the Minenergo [the USSR Ministry of Power Industry and Electrification] system requirements for nuclear power plants are very much lower than in the Ministry of Medium Machine Building Industry. In particular:

- a) the number of attending personnel is reduced;
- b) one regularly makes commitments to reduce the length of planned repairs by 6 to 7 days, including repairs of the 4th power generating unit;
- c) in the opinion of specialists the quality of equipment that has been shipped in the last 10 years has deteriorated by a factor of two. AESs receive a very large amount of defective equipment from manufacturing plants, and there is not enough instrumentation;
- d) it takes the Minenergo 3 to 4 months to satisfy requests for even urgent repairs, because a prolonged letter exchange is required. In the Minseredmash [the USSR Ministry of Medium Machine Building Industry] it takes a week at most;
- e) the security at operating power generating units is clearly insufficient;
- f) in recent years Minenergo's attitude towards nuclear power plants has become the same as towards TETs and GES. No clear differentiation between nuclear and regular power generating units is being practiced.

8. The sluggishness of the local authorities is striking. No clothes, shoes, underwear or linen was made available for the victims; one was waiting for instructions from Moscow.

9. The panic mood in Kiev was created due to a number of factors, but first of all due to lack of information: not even on what happened but on the radiation situation in the city. Foreign propaganda had a great effect, but none of the Republic's leaders, who could have said very simple words to the effect that there was no reason to worry and no danger to kids' and residents' health, appeared on radio or TV. Comrade Lyashko appeared on TV for the first time only after meeting with foreign journalists.

Information on Comrades Ligachev and Ryzhkov's trip to the AES area had a positive effect. However, in my opinion the "silence" of Republics' leaders had again aroused panic, especially when it became known that children and family members of top-level officials were

being evacuated from the city. There was a 1000-people-long line at the ticket offices of the CPU [Communist Party of Ukraine] Central Committee. Naturally, this was well known in the city.

On May 5 the URSR [Ukrainian Soviet Socialist Republic] Minister of Health made an unfortunate, in my opinion, TV appearance, which in turn caused a new wave of panic. TV stations were mainly showing dancing groups and other subjects, although very simple information on the radiation situation in the city and simple commentaries by scientists and specialists of which there are a sufficient number in Kiev would have removed the stress, as it happened after publications in central newspapers. After all, those in the CPU Central Committee were waiting for instructions from Moscow although it was possible to prevent the rise of a panic mood right away. Incidentally we were always running into the following comment: "We have not received such an instruction from the center..."

There is an exception. Secretary of the Kiev Party obkom Comrade Revenko was constantly informing raykom Secretaries and via them rank-and-file Communists about the actual state of the matter; it is a good thing that he was regularly visiting Chernobyl. And this was bringing fruit—in the oblast there was no panic similar to what we were observing in Kiev.

10. At present the people's mood has changed drastically. But liquidation of the consequences of the accident is actually just beginning. A new explosion has been averted, but the difficult radiation situation remains. Liquidation of the consequences will take from several weeks to a number of months. It will be long before people are able to return to their homes. And this must be explained to them, as must be explained a number of rudimentary rules of life in a territory hit by radiation. Including such "trifles" as that this year one should not be picking mushrooms here ... etc.

And the main thing—it is exactly now that it is necessary to categorically strengthen the safety of people working in the zone. While during the first stage there could have been exceptions due to the extremely complicated situation, at present there can be no excuses for exposing people to radiation.

It is necessary to assiduously analyze all lessons of the tragedy for the sake of the thousands of people who are unselfishly fighting the disaster. The people have united and taken upon themselves the entire burden, oblivious to the consequences. For instance, several people (in particular Major L. Telyatnykov, Lieutenants V. Pravyk and V. Kibenok etc.) localized the accident and saved the power plant. They knew they were getting a lethal dose of radiation, but in spite of this they did not leave the site of the power generating unit until the fire was extinguished. In my opinion they deserve the Hero of the Soviet Union title. They have a short time left to live, but why wait until all necessary documentation is ready? This will take months.

Naturally, I do not have complete information about these events, but I consider it my duty to share with you what I have seen.

**V. Shcherbitskiy:** "The Situation in Kiev ... Is Healthy and Business-Like"

Understanding their responsibility for a timely and efficient solution of problems coming up as a result of the accident at the Chernobyl AES, the Party, Soviet and business bodies of the Republic are demonstrating a high level of preciseness and discipline in their work. In order to perform assignments of the Government Commission on Liquidation of the Accident and other urgent tasks, an operative group of the Communist Party of Ukraine Central Committee under the management of Comrade Lyashko O.P. has been formed.

89,360 people have been evacuated from the dangerous zone, including 62,746 people from the towns of Prypyat and Chernobyl. Among the evacuees are 27,400 children and 14,500 retirees. All of them have been provided temporary living quarters, and over 92 percent of the able-bodied population have jobs. As of May 22, 52,337 people have received financial help in the total amount of R10.5 million. Retail and consumer services have been organized in places where they live.

240 physician and nurse teams, 160 laboratory technicians and dosimeter operators, and sanitary vehicles have been sent from other oblasts to the evacuation areas. 245,277 people have received a checkup. Since the accident 9,127 people have been hospitalized and received preventive treatment at the Republic's health facilities, including 312 MVS [the Interior Ministry] employees. 161 people have been diagnosed with the radiation diseases, including five children and 49 MVS employees. They are being given skilled medical help.

Children are being given special care. All school-age children in the 30-km zone and areas adjacent to the AFS—a total of 26,900 children—have been sent for rest to pioneer camps in the Republic's other oblasts. Pregnant women and nursing mothers with children have been placed in the Kiev oblast health resorts and boarding houses.

Like in previous years, during the second half of May first to seventh grade students in Kiev are being sent for summer rest.

Dosimetry control of the status of air, soil, water, food products, plants and domestic animals is conducted systematically. A strict regime for movement of people and means of transportation to the AES zone and adjacent areas has been established. Patrols and fire protection in the towns of Prypyat, Chernobyl and other settlements in the 30-km zone are provided.

All issues related to improvement of health, organizing day-to-day life and employment of the evacuated population are under continuous control of the Communist Party of Ukraine Central Committee and Republic's

Council of Ministers, as well as appropriate local bodies. Organization and political work is conducted continuously in places of residence of the evacuated population. The public opinion is being carefully studied, information is regularly given to the Party active and population, and fabrications of the bourgeois propaganda and various rumors are being unmasked. In the evacuation areas a proper public order is maintained, and transportation needs are met fully and on a timely basis.

Everywhere in the Kiev oblast and the city of Kiev open Party meetings have been conducted, where tasks of Party organizations in the situation that had formed have been discussed.

The Communist Party of Ukraine Central Committee has thoroughly analyzed the work conducted in the Republic in relation to the accident and uncovered deficiencies that were taking place. In certain cases carelessness was exhibited, as well as the inability of certain Party, Soviet and business officials to take responsibility, make timely decisions and organize retail and consumer services for the evacuees.

... Measures on compensation for damage caused by the accident have been delineated. The damage is substantial...

In this regard the Communist Party of Ukraine Central Committee and Republic's Party organizations are paying special attention to ensuring a steady-pace harmonious operation of the entire national economy of the Republic and unconditional fulfillment of 1986 plans and socialist obligations. The goal has been set to achieve an increase in production at each work station and in each working collective compared to the plan in order to compensate for the sustained losses.

The Council of Ministers of Ukraine is developing measures on providing permanent housing for the evacuated population before the onset of the fall and winter season.

In addition to problems related to conservation of power generating unit #4, performing decontamination of the territory and putting units ## 1 and 2 into operation it is necessary to consider a set of measures on protecting rivers Prypyat, Desna and Dnieper from contamination, determine rules for compensation of state and cooperative organizations for material losses, and write off outstanding long- and short-term Derzhbank SRSR [the USSR State Bank] credits to evacuated enterprises and organizations of the agro-industrial complex.

The situation in the city of Kiev and Republic is healthy and business-like.

The TV speech by the General Secretary of the CPSU Central Committee Comrade Gorbachev has had a great effect on increasing mobilization of Communists and all workers.

The workers value very highly the measures taken by the CPSU Central Committee Politburo on liquidation of



the consequences of the accident and the care that is being given to the population.

People have an understanding attitude regarding the difficulties that have appeared; they are striving to personally help at the fastest pace to overcome these difficulties and strongly believe that everything possible will be done in order to normalize the situation in the Chernobyl AES region.

©Translation from Russian by V. Sylchenko [VISNYK UKRAYINY]

### Officials Allegedly Reluctant To Close Down Chernobyl Plant

AU1310133592 Kiev HOLOS UKRAYINY in Ukrainian 6 Oct 92 p 7

[Commentary by Leonid Hashyn: "Parliamentarians Will Regulate?"]

[Excerpt] It is known from official sources that, after the explosion of the reactor at the Chernobyl Atomic Electric Power Plant, 96 percent of the nuclear fuel remained within the energy unit. However, so far, not more than a quarter of the entire fuel has been found in the "Ukrytya" [shelter] facility. As for the rest of this fuel, it either escaped from the reactor or remains in those places that have not yet been able to be reached by the investigators of the "sarcophagus."

This was reported by Ukraine's People's Deputy V. Usatenko at a meeting of the Supreme Council Standing Commission for Questions of the Chernobyl Catastrophe. The deputy recently acquainted himself with the situation at the "Ukrytya" facility. Speaking about systems of control over nuclear fuel, he drew attention to the fact that the readings of these systems are sometimes appreciably different. Nor do the results of measurements of the movements of fragments inside the "sarcophagus" match, results that were made by specialists from the Ukrainian Geological Committee and by members of the former Comprehensive Team, following the 1990 earthquake.

There also are organizational problems on top of the strictly technical ones. For example, the Cabinet of Ministers has not yet appointed a juridical person who would be answerable for the state of the "Ukrytya" facility. This is very alarming.

V. Usatenko also spoke about the progress of work aimed at preparing the Chernobyl Atomic Electric Power Plant for closure. In his opinion, the administration of the plant does not seem to be in a hurry to do this. For some reason, the boilers for an emergency boiler house and an additional four boiler cars [kotlovahony] are still being stored as far away as Slavutych. If there is no boiler house by summer, it will not be possible to halt the Chernobyl Atomic Electric Power Plant. Then, perhaps,

the operating plant will be "caught" in the winter of 1993-94. Such a cold period of the year is not the time to be giving up energy.

M. Umanets, president of the "Ukratomenerhoprom" concern, is not playing hide-and-seek. He offers quite a few arguments in favor of the Chernobyl Atomic Electric Power Plant's operation until the full exhaustion of its potential. It is true, though, that V. Usatenko only mentioned one of them: The Chernobyl zone is also a security measure, because it may absorb radioactive emissions before they reach the population. [passage omitted]

### Ukraine Views Options for Replacing Chernobyl Sarcophagus

93WN0105C Moscow RABOCHAYA TRIBUNA in Russian 3 Nov 92 p 2

[Article by Georgiy Dolzhenko: "How Sound Is the Sarcophagus?"]

[Text] Scientists have noted that time is passing faster than usual for the sarcophagus encasing the wounded block of the Chernobyl Nuclear Power Plant. No, not for people but for concrete, metal and other materials. The ultrahigh-strength structures, which bullets can't even scratch, the steel girders, the welded seams, bolts and nuts have noticeably aged and have begun to deform under the influence of radiation over the 6 years since the shelter was built. Today there are approximately 2,500 square meters of cracks over its surface. And instead of the planned 30 years' life of the sarcophagus, it is now given only 5-10 years.

Why the miscalculation? After all, the negative influence of radiation upon materials has been known to specialists since radioactivity has been known. The experience of scientists 40 years ago is well known: They lowered a sheet of plywood into a reactor, and it transformed into a friable mass reminiscent of a thin slice of bread.

Processes are going on swiftly within the structure as well. The lava-like mass consisting of chunks of nuclear material and structures, which had clinkered together into a monolith, has begun breaking down and forming dust, which was not foreseen by the scientists either. Water getting into the structure has intensified migration of fuel particles. They are now accumulating in certain places, and there was a time when the fuel mass approached a state close to critical. The situation was rectified with proper engineering decisions made by Viktor Popov, an associate of the integrated expedition of the Atomic Energy Institute imeni I. Kurchatov. He gave orders to cover the structure with a thin layer of adhesive neutron-absorbing polymer. Now this procedure is periodically repeated for preventive purposes.

The sarcophagus raises alarm for another reason as well. Rain water percolating into the ground contaminates soil water, which lies close to the surface here.

All of this has made it necessary for society to consider the following question: What is to be done with the sarcophagus? Understandably, we have to get rid of it. But how? Numerous ideas have been offered. Some have proposed covering all of Power Block No 4 with concrete, transforming it into a huge cube, and leaving it for future generations. They'll think of something then.

There was the enticing idea of dismantling the ruins completely, together with the fourth block, burying all of the material, and planting a green meadow over the area. But once again, where are all of the special equipment and money to be obtained? And most importantly, it would take many years to carry out the project.

The most realistic idea of all is to build "Shelter-2" over the existing sarcophagus. When the initial structure collapses and clouds of radioactive dust are set free, it will keep it from spreading, and it will allow us to keep processes occurring in the ruins under observation. None of the versions has yet been adopted. The Ukrainian Cabinet of Ministers has announced an international contest to come up with a way to transform the shelter into an ecologically safe system. The prizes are: first (1)—\$20,000, second (2)—\$10,000 each, and five runner-up prizes of \$5,000 each.

Send proposals to: 252196, Kiev, Lesi Ukrainki Square, 1, Ukrainian Chernobyl Ministry.

Telephone: 296-31-99.

### September Nuclear Power Plant Breakdowns Profiled

OW2110195292 Moscow INTERFAX in English  
1940 GMT 21 Oct 92

[From the "Business Report"—item transmitted via KYODO]

[Text] In September 1992 there were 11 registered breakdowns classified as accidents at Russian nuclear power plants, the republican Ministry for Atomic Energy has announced. In one case the automatic security system went into operation.

Unplanned shutdowns at power units which received a "zero" rating according to the International Incident Classification (IIC) occurred at the power plants in Balakovo (Volga region, equipped with a water-cooled reactor with thermal neutrons) and in Novovoronezhskoe (Central Russia, water-cooled reactor). Over the first 9 months of 1992 the nuclear power plant in Beloyarsk (Western Siberia), which is the only operating nuclear power plant in Russia with a fast neutron reactor, did not have a single accident. Radiation emission levels at the Beloyarsk plant are lower than levels at other nuclear power plants.

From January through September 1992 there were 12 shutdowns at nuclear power plants in Russia (over the same period in 1991 there were 13). Six of the shutdowns

were due to human error, in three cases due to repair work and at three installations the directors of the plants were at fault.

Average daily radioactive emissions of gases and aerosols at Russian nuclear power plants in September 1992, according to the Ministry of Atomic Energy, were not above the accepted average levels.

Over the first 9 months of this year the plants were operating at 66.3% of their power capacity as compared to 66.0% during the same period last year. In September 1992, however, nuclear power plants were operating at 70.9% of capacity. [Table on breakdown ratings at power units not reproduced]

The parentheses show the number of unplanned shutdowns at power units. The only power plant shown in the table which has a reactor like the Chernobyl one is the Leningradskaya plant (located in a suburb of St. Petersburg). The nuclear power plants in Balakovo, on the Kolsky peninsula and in Novovoronezhskoye are equipped with water-cooled reactors, the plant in Beloyarsk has a fast neutron reactor.

### Ukrainian Nuclear Power Plants in July

927F0331F Kiev PRAVDA UKRAINY in Russian,  
21 Aug 92 pp 2

[Article by Editorial Board]

[Text] In the past month, four out of the five operating nuclear power plants were working in Ukraine. The Chernobyl NPP has not been put in service. Preventive scheduled maintenance is still underway in a number of generating units. This is what correspondents of the Ukrainian information agency operating in the areas where the NPPs are located have been told.

### Zaporozhye Nuclear Power Plant

Its meters have recorded 150 billion kWh. This is the quantity of electric energy it generated since the start of the first unit in 1984. Today, five units operate there. Yet in July, the station operated only at a 60% capacity. The reason: scheduled maintenance of the second and fourth generating units. Moreover, unscheduled shutdowns of the basic equipment were necessary. A relatively serious violation was recorded in the second generating unit which is under repairs where there was a leak of contaminated service water through the service pump seals. According to the international safety system used, this is classified as the first level on the international NPP scale of events.

### Southern Ukrainian Nuclear Power Plant

In the past month, the second and third generating units operated at the NPP. On 18 July, the second generating unit was put in operation after scheduled maintenance. The total electricity output during the month was equal to 1 billion 45.8 million kWh.

### Rovno Nuclear Power Plant

In July, the station fulfilled the allocated technical and economic indicators. There were brief disruptions in equipment performance but they did not affect the safety levels. The third generating unit put into service after scheduled preventive maintenance was shut down again to eliminate the malfunctions which had developed in the electrical generator circuit. All remaining systems and equipment operated stably.

### Khmelnitskiy Nuclear Power Plant

The first (the only one in operation) generating unit is under scheduled preventive maintenance. Discharging of spent nuclear fuel from the reactor began on 13 July. At the same time, the fuel element cladding seal is being monitored. In the turbine section, the generator, turbine set, and auxiliary equipment are under repairs. Maintenance of the third safety system has been completed while the second system is next to be serviced.

The radiation environment in the area of all operating nuclear power plants does not exceed the natural background values. The average daily releases of radionuclides into the atmosphere through the ventilation stacks do not exceed a tenth of the percentage point of the established standards.

### Ecology Ministry Details Secret Nuclear Tests in Kazakhstan

PM1011125192 Moscow IZVESTIYA in Russian  
29 Oct 92 Morning Edition p 2

[Report by Oleg Stefashin: "Nuclear Explosions in Kazakhstan Were Carried Out in 27 Places"]

[Text] On the instructions of the government, the Kazakh Ministry of Ecology and Biological Resources has collected information, formerly thoroughly concealed, on so-called one-shot nuclear weapons tests carried out outside the Semipalatinsk test site.

It turns out that 38 nuclear explosions of differing yields were carried out at 27 different places over the years. Atyrau Oblast was used most actively for these purposes; in all 17 tests of mass destruction weapons were carried out there. Eight nuclear charges were exploded at test sites in the Urals area, and the rest in Aktyubinsk, Akhmolinsk, Mangistau, and South Kazakhstan Oblasts. In the opinion of staff of the Ministry of Ecology and Biological Resources, the data they have compiled throws light on the scale of the damage inflicted on the republic by nuclear weapons tests, and will also make it possible to take more effective measures for the ecological protection of Kazakhstan's population and environment.

### Draft Law on Radiation Safety To Undergo Further Review

92WN0813B Moscow NEZAVISIMAYA GAZETA  
in Russian 22 Sep 92 p 6

[Report by Andrey Bayduzhiy: "Law on Radiation Safety of the Population Submitted to the Government"]

[Text] The collegium of the State Committee for Medical-Epidemiological Control approved for further consideration a draft Russian Federation law "On the Radiation Safety of the Population," commissioned by the government to a group of scientists from the Leningrad Radiation Safety Scientific Research Institute. According to this law, the per-capita maximally admissible radiation dose is set at 0.1 rem per year, excluding natural and medical radiation sources. In the case of people who handle radioactive materials, this standard has been raised to 5 rem per year, which is consistent with the standards adopted by most European countries. All enterprises using sources of ionizing radiation must be licensed. One of the conditions for obtaining a license is making payments to a special insurance fund to compensate the population in the event of a radiation accident.

The draft law stipulates the right of citizens, public organizations, and information media freely to obtain from local self-governing authorities objective information on the radiation situation. Individuals guilty of concealing or distorting such information will be held administratively or criminally liable. The basic indicators of the level of population radiation safety will be recorded annually in the region's radiation-hygiene passport. Citizens who live in territories with higher radiation risk, or in the vicinity of enterprises handling sources of ionizing radiation have the right to compensations, the procedure and amounts of which are to be determined by the government. The right to be compensated for the damage caused by any radiation effect will have no statute of limitations. Various types of liability are stipulated for the theft, illegal acquisition, storage, or damage to sources of ionizing radiation or for holding unsanctioned meetings in sites where such sources are located.

It is anticipated that in addition to the radiation safety law, Russian nuclear law will consist of three other laws: on nuclear weapons, the use of atomic energy, and state policy pertaining to radioactive waste.

### Finnish Signaling System at Our Nuclear Power Plants

927F0305A Moscow IZVESTIYA in Russian  
29 Aug 92 p 5

[Report from Helsinki by Marat Zubko, an IZVESTIYA correspondent]

[Text] In the near future the Finnish experts will be provided a unique opportunity of constantly monitoring

the situation at the three nuclear power plants located on the territory of the former Soviet Union which, in the opinion of Western experts, are the most potentially dangerous plants.

We are talking primarily about nuclear power plants (AES) in Sosnovyy Bor near St. Petersburg, Polyarnyye Zori in the Kola peninsula, and Ignalina in Lithuania. A Finnish system which will be linked directly to Finland will be installed at these plants. Eventually this system will be extended to other northern European countries as well as Germany. According to the Finnish press, the seaport in Murmansk which is the home base to nuclear powered icebreakers will also be equipped with such a system.

Needless to say, in operating nuclear power plants, the issue of informing the population of our own country and the authorities in other countries is especially important. The tragic experience of Chernobyl is vivid proof to this premise. Quick notification is called upon to help evacuate the maximum possible number of people from the "radioactive impact" and save their lives.

Unfortunately, not everything has been worked out to perfection in this field. Yes, there are international agreements according to which the countries' authorities are required to quickly inform the governments of other states in the case of a nuclear catastrophe. Yet these notifications may be delayed due to bureaucratic procedures, failures of telephone communications and other information transmission means, or for other reasons.

In reality, the situation may develop exactly as it happened with a leak of radioactive vapors from the Sosnovyy Bor AES in late March. Back then, the emergency notification reached the neighboring Finland only 7 hours later. Moreover, not the authorities but the mass media were the first to learn the news. Yet many Finnish citizens live close by.

In addition, it turned out that the first report somewhat overstated the degree of danger. According to radio and TV news, a radioactive cloud was moving toward Finland; this news generated a real panic in the southern and southeastern regions of the country.

We should note that other countries using nuclear power are also not linked by a common signaling system. Why then are the three AES in the former USSR being monitored? One of the leaders of the Nuclear and Radiation Safety Center Hannu Koponen answered this question.

In his opinion, the nuclear power plants which were built on the Soviet Union territory cannot be overhauled to the extent necessary for bringing the degree of their safety to Western standards. Consequently, we are implementing a signaling system which will enable us here in Finland to quickly assess the situation at these three AES.

According to the Finnish press reports, the signaling system will begin to be operational in the early fall.

### **Mysteries of Sarcophagus**

927F0331D Moscow ROSSIYSKAYA GAZETA  
in Russian, 1 Sep 92 pp 5

[Article by Vladimir Gubarev]

[Text] A recent report that the tomb wall has cracked and powerful radioactivity fluxes are pouring into the atmosphere caught us in the office of the Chernobyl NPP director. 'Us' is a group of scientific journalists who later formed a "Nekos" studio and our French colleagues from *Le Monde*, *Figaro*, *L'Humanite*, and other newspapers. Several minutes later we were near the tomb, the very wall which supposedly "collapsed". The dosimeters recorded an elevated background yet it was the same yesterday as it was a month or a year ago... The "crack in the tomb" turned out to be yet another "hoax" which regularly appears in various publications

In fact, I shouldn't blame my colleagues since the danger is real and its name is the "Sarcophagus in Chernobyl". Yet the danger is not in the cracks but in the gigantic structure itself which encases the blown-up fourth generating unit of the Chernobyl NPP.

Yes, this "encasing" was built in the shortest time but this does not mean that it was done in a hurry. Specialized construction teams were working on the site of the fourth generating unit under awful conditions of high radiation fields. The same people who erected uranium plants and built mines and warehouses for uranium nuclear fuel and high-power reactor vessels. These are professionals of the highest order who are accustomed to being responsible for the quality of their work. They were the first to reach the tomb roof after completing construction and they were the ones who guaranteed that the "encasing" will reliably protect the damaged reactor. Unfortunately, the heroic deed (and it is difficult to find different words!) of the tomb builders has not been appreciated enough and the experience of their work has not been covered even in specialized publications and not studied at institutions of higher learning. It's a pity. Who knows whether it may be necessary to construct something similar on the planet...

Six years have passed. An official commission recently confirmed: the "encasing" is still reliable and there is more time left. Yet soon a new protection will be necessary for the fourth generating unit—like everything in the world, the tomb is also aging. In my opinion, the development of the "tabernacle" project is proceeding too slowly and there is a shortage of funds. The shutdown of the Chernobyl NPP, the division of the tragedy into three parts—Ukrainian, Belarussian, and Russian—and the absence of a clear order of priorities in cleaning up after the catastrophe, all this brings us step by step closer to a new nuclear accident. And if we don't begin today, this hour, working on the future protection system of the fourth generating unit, some other bright morning



we will learn: the tomb has indeed collapsed and cracks have appeared in it and then, new enormous efforts will be necessary to tame the nuclear demon. Yet those builders whose autographs can be found in this picture will not be able to come here—they were exposed to excessively high doses in 1986 and paid for our safety with their own health and lives.

### New State Committee Provides 'Objective' Data on Nuclear Safety

93WN0115A St. Petersburg

SANKT-PETERBURGSKIYE VEDOMOSTI

in Russian 22 Oct 92 p 4

[Article by I. Vasilyeva: "The Atom—Under Supervision"]

[Text] Radiation safety is one of the topics capable of giving rise to the most varied rumors. We are afraid of "radioactive" rains, mushrooms, vegetables and fruits, atomic power plants and submarines... Fear of the unknown is the most terrifying thing, and, as a rule, we know very little about radiation. And how could we know? This topic has always been shrouded in secrecy. Henceforth, information on any incidents (if they should occur, God forbid) may be obtained from a truly informed source. At the directive of B. N. Yeltsin, the State Committee for Control of Nuclear and Radiation Safety [Gosatomnadzor] was created several months ago. The Russian Gosatomnadzor is answerable directly to the president, and is not subordinate to any departments. Therefore, its information is the most objective.

The tasks of Gosatomnadzor consist of regulating and controlling safety in the production, handling and application of atomic energy, nuclear materials, and radioactive substances for peaceful and defense purposes.

The Russian Gosatomnadzor is comprised of seven territorial districts. St. Petersburg, along with Karelia, Murmansk, Arkhangelsk and other oblasts is part of the North European district. The new service has more than enough work to do. As the chief of the North European district administration, V. I. Martynov, stated, in St. Petersburg alone, 970 different enterprises have been taken "on account," and in Leningrad Oblast—around 450. Moreover, the Baltic and Northern Fleet, the Murmansk Steamship Line, and the Leningrad Military District have been taken under control.

We might add that in the opinion of Gosatomnadzor associates, the actions of the military today present the greatest radiation danger, since up until recently they were controlled only by their own military services. Now the control will be independent. In second place is industrial pollution arising from careless handling of radioactive sources. But certainly not at atomic power plants, whose associates are most competent. Radioactive isotopes are used today in many spheres of practical activity: In industry, medicine, etc. However, the people working with them by far do not always adhere to industrial safety regulations. And recently new concerns

were added: Sources of radioactive emissions have become the objects of... theft. Thus, at the Kingisepskiy production association "Fosforit," 14 radiation sources, which contained cesium-137, were stolen. Not to mention the value of these instruments, their unskilled handling presents a serious hazard. Recently, two of the stolen sources were found: In Latvia and Estonia. Evidently, like non-ferrous metals, they were profitably sold "abroad"...

The immediate plans of the St. Petersburg inspection of Gosatomnadzor include the licensing of enterprises at which radioactive sources are used. Work will be continued only by those where all safety conditions will be adhered to. The personnel will have to pass exams or tests. And we need have no doubt of the fact that the "examiners" themselves are competent persons. Most of the Gosatomnadzor associates have served in radiation safety services for 30 or more years.

The contact telephone number for the North European district of Gosatomnadzor, whose center is in St. Petersburg, is 310-51-35. Yuriy Ivanovich Khoipunov, who is responsible for community relations, is ready to answer all questions concerning radiation and nuclear safety.

### Slide Rule for Assessing Radiation Danger

927F0305F Moscow TEKHNIKA I VOORUZHENIYE

in Russian No 5-6, 92 p 16

[Article by Candidate of Technical Sciences, Associate Professor, Col. A. Karasev]

[Text] This device which can be conveniently used in the field was developed at the Saratov Chemical Defense Engineering Academy. The slide rule makes it possible to determine the radiation dose to which personnel working on terrain or inside the equipment with induced radioactivity have been exposed during any time interval (even until the total drop in radioactivity); the time when it is safe to begin operation or evacuation, engage in combat inside the vehicles or on terrain with induced radioactivity; the time which can be safely spent on the equipment or in the equipment or on the terrain with induced radioactivity (so as not to exceed a specified dose); and the time during which radioactivity decreases to a certain dosage rate level.

The dosage rate measured by the DP-5V or IMD-1R instruments above the equipment (at a 1-2 cm measuring height) or above ground (at an 80-100 cm measuring height) as well as the elapsed time since the measurement moment are used as the initial data. No data are required on the explosion yield and the elapsed time after the explosion.

The slide rule has a housing with a rotating disc inside. A text with examples of a problem solution is pasted to both sides of the housing. In addition, there is a slot in the housing for taking the radiation dosage reading from the disc. The dosage rate values are written around its circumference while the value of the dose to the total



radioactivity decay is indicated under each digit. One side of the disc contains data for armored vehicles and cars, while the other is for aircraft, airborne equipment, soil, and provisions. More detailed information about the slide rule is available from the Academy.

### No Danger to Reactor

927F0305D Alma-Ata KAZAKHSTANSKAYA PRAVDA  
in Russian 1 Jul 92 p 1

[Article by O. Kovalenko]

[Text] Last week, Aktau, the administrative center of the Mangyshlak oblast, was feverish. All kinds of rumors, one scarier than the other, were making the rounds: a nuclear power plant accident, numerous fatalities, the reactor has miraculously survived.

According to the deputy director of the Mangyshlak Energy Enterprise, Doctor of Physical-Mathematical Sciences V. Shkolnik, there was a short circuit during the preventive maintenance operations at the plant for making the distillate. This tripped the protection devices in the fast neutron reactor, and, as a consequence, the reactor output dropped by 20 percent. As a result of the accident, Aleksandr Tolkishevskiy, a duty electrician, was killed.

A commission set up to investigate the accident established that the short circuit was caused by a serious breach of the rules for carrying out scheduled preventive maintenance operations and safety engineering on the part of the victim. There was no danger to the reactor. The enterprise is functioning normally.

Krasnoyarsk. Less than 3 minutes after the chief engineer of the Krasnoyarsk Integrated Mining and Chemical Works Igor Sidiyakin pushed the emergency safety rod release button, the first plutonium-making reactor which has operated for more than 30 years was shot down forever. Yenisey contamination with radioactive water which was dumped into the river after the plant cooling has also ceased forever.

### Echo of Past Tests

927F0305C Alma-Ata KAZAKHSTANSKAYA PRAVDA  
in Russian 1 Jul 92 p 2

[Article by V. Bugayev, KAZAKHSTANSKAYA PRAVDA stringer]

[Text] Experts from the State Meteorological Center of the Kazakhstan Republic have measured the concentration of artificial  $^{137}\text{Cs}$  and  $^{90}\text{Sr}$  radioactive isotopes in the Irtys basin in Pavlodar kray. At two control points of the Krasnokutsk rayon at a distance of 320-370 km from the Semipalatinsk nuclear testing ground, their concentration in the soil exceeded the mean level for the country (namely, the former USSR) by 1.14-2 times. In seven soil samples taken in Mayskiy rayon at a 110-160 km distance from the testing ground, their concentration

exceeded the mean by 1.18-3.3 times. No cesium or strontium was detected in the air—they were recorded only in the soil.

### Kemerovo: Chernobyl Is Moving to Kuzbass?

927F0305B Moscow ROSSIYSKAYA GAZETA  
in Russian 15 Aug 92 p 5

[Article by Aleksandr Yermakov]

[Text] The press center of the Kemerovo oblast council has disseminated the information indicating that Aman Tuleyev, the council chairman, has sent a telegram to the president of Russia and the chairman of the Supreme Council, as well as to the state Chernobyl committee.

Aman Gummirovich has information that in September 1984 a nuclear explosion was conducted in the northern part of Kemerovo oblast. Moreover, almost 30 years ago the hydrogen [bomb explosion] fallout brought from the Semipalatinsk testing range "touched" the southern regions of Kuzbass. On the basis of these data, the Kemerovo leader is requesting the highest levels of government in the federation either to confirm or to deny this information or appoint an official commission to carry out a proper investigation. In A. Tuleyev's opinion, in the case of an "affirmative" response it would be necessary to allocate sufficient finances for the treatment and prevention of the affected population.

Since the government has not responded to the previous request, the oblast council chairman has prepared documentation for submission to the arbitration court. On its part, the oblast council has set up commissions of representatives which are called upon to travel to the state Chernobyl committee and to Semipalatinsk.

Being a resident of Kuzbass myself, I am hopeful that Aman Gummirovich is either wrong or has been misled for whatever reason.

### Greenpeace Assesses Nuclear Waste in Kara Sea

#### Details Dumping Sites

AU1910150492 Frankfurt/Main FRANKFURTER  
ALLGEMEINE in German 19 Oct 92 p 1

[Report by "rieb": "Former Soviet Union Dumped Nuclear Waste in Sea"]

[Text] Frankfurt, 18 October—The former Soviet Union apparently dumped huge quantities of nuclear waste and even reactors with fuel rods in the sea. According to the Greenpeace ecological organization, there are 17,000 barrels and containers with radioactive waste in the Kara Sea in the Arctic near the Novaya Zemlya string of islands. In addition, 15 nuclear submarines were sunk there, some of which still have fuel rods in their reactors, Greenpeace nuclear expert Laing told this newspaper. He added that the Kara Sea is "the world's largest nuclear dumping place." Laing said that he had his

information from Russian military officials. In February 1992, Aleksandr Emelyanekov, a former Supreme Soviet deputy, officially asked the Russian Government how much nuclear material was disposed of in the Kara Sea. The government admitted that 12 nuclear submarines were sunk in the Kara Sea, and it also confirmed the figures on the barrels dumped there. There was the danger, said Laing, that plants and fish in the Kara Sea and in adjacent waters would be radioactively polluted.

#### **Seeks Independent Investigation**

*OW2110212092 Moscow INTERFAX in English  
1928 GMT 21 Oct 92*

[Following item transmitted via KYODO]

[Text] The International ecological organization Greenpeace urges all participants in the London Convention banning the burial of nuclear waste in seas to request the Russian government to allow a complete independent investigation of the places where nuclear waste had been buried in the Kara Sea.

The organization would like the Russian government to guarantee that nuclear waste be never thrown in seas. This was said in a press report issued by the Greenpeace Moscow representation Wednesday.

The head of the representation John Sprange said that a meeting of the London convention participants in November will focus on a draft full ban on the burial of radioactive waste in seas.

As IF [INTERFAX] reported earlier, the Greenpeace "Solo" vessel detained by Russian border guards has already been released and is moving toward Norway.

#### **Novaya Zemlya Test Site Given 'Satisfactory' Ecological Ratings**

##### **Parliamentary Group Inspects Area**

*OW1310150992 Moscow INTERFAX in English  
1429 GMT 13 Oct 92*

[Following item transmitted via KYODO]

[Text] The 87 atmospheric and 3 underwater nuclear tests carried out from 1955 till 1962 largely accounted for nuclear contamination in the region of the Novaya Zemlya testing ground. The 42 underwater nuclear tests, carried out from 1964 to the 1990s did not cause the radiological situation to deteriorate seriously. This information was revealed on Tuesday by Valeriy Menshikov, Vice-Chairman of the Russian parliament's Committee for Ecology and Natural Resources who led the parliamentary group which visited Novaya Zemlya on October 6 to 8.

He said that the radiation situation is mostly favorable in the region and that the radiation levels were even lower than in Moscow—9 to 17 micro-RAD. However, this conclusion does not refer to three areas with higher

radiation levels. Menshikov said that the final conclusions will be made following a comprehensive ecological analysis.

According to "unofficial information concerning the place where radioactive wastes are buried", it is within the 12-mile zone, which means that it is within the limits of the Russian border. He noted at the same time that to this day the dumping of nuclear wastes in the Kara and Barents seas is not controlled.

"The most painful problem is the need to carry out ecological checks in the Yamal Peninsula and in the Yamal-Nenets autonomous district," he said.

Menshikov noted, answering INTERFAX's question, that the Novaya Zemlya archipelago and the adjacent regions cannot be automatically put on a par with the regions affected by Chernobyl and that the ecological programme will not apply to them.

Secretary of the parliamentary Committee for Defence and Security Valeriy Shuikov announced during the press conference that on October 28 the parliament will hold hearings on nuclear tests. The MPs intend to send an inquiry to the government, requesting exhaustive information on the radiation levels in the Novaya Zemlya region.

The speakers stated that during the next 9 months, Russia will not carry out nuclear tests in Novaya Zemlya. The future of nuclear tests, they said, will depend on joint decisions to be taken by the three major nuclear powers—the U.S., France and Russia.

#### **Arctic Ecology Conference Backs Conclusions**

*OW2210172292 Moscow INTERFAX in English  
1433 GMT 22 Oct 92*

[Following item transmitted via KYODO]

[Text] The level of radioactive contamination in the area of the Novaya Zemlya nuclear testing ground is not nearly as high as that in the areas where nuclear weapons are manufactured, such as the Southern Urals or the Chelyabinsk-40 zone. Such was the conclusion made by scientists from the U.S., Norway, France, Russia, Ukraine, and some other countries who attended an international conference on the ecological problems of the Arctic and prospects for nuclear disarmament held in Archangel on October 15-17.

Valeriy Menshikov, one of the conference organizers and Deputy Chairman of the Ecology Committee of the Russian Supreme Soviet, told INTERFAX the detailed aerial maps of Novaya Zemlya prove the conclusion of a parliamentary commission which visited the archipelago early this month that the area's ecological condition is nearly satisfactory.

At the same time, Menshikov supported the Supreme Soviet's position, which refused to make the final conclusions before the government disclosed its information

on nuclear waste dumps in Novaya Zemlya. The government is to reply to the Supreme Soviet's relevant inquiry before November 6, 1992.

### **Commission To Ensure Safe Burial of Radioactive Wastes**

*LD1210173292 Moscow Radio Rossii Network  
in Russian 1300 GMT 12 Oct 92*

[Text] A commission for ensuring the safe burial of radioactive wastes has been set up in Russia. An instruction to that effect has been signed in the government. The Commission's chairman, Vice President of the Russian Academy of Sciences Nikolay Laverov, stated in a conversation with a TASS correspondent that the commission's specialists will conduct fundamentally new research and also select plots that are suitable for burial.

On the whole the burial of radioactive wastes will be effected by introducing them into a solid mass as this method is the safest. Scientists are now developing a compound of minerals that would be capable of encasing [vospriniimat] radioactive substances and reliably storing them for no less than 150,000 years.

### **Official Comments on Radiation Safety Controls**

*LD1210171892 Kiev Radio Ukraine World Service  
in Ukrainian 1900 GMT 11 Oct 92*

[Text] There are currently more than 200,000 sources of radioactive emissions in Ukraine and they are all subject to strict control, according to Kopchynskyy, first deputy chairman of the Ukrainian State Committee for Nuclear and Radiation Safety. Regarding the safety problem, in particular concerning the reactor at the Nuclear Research Institute at the Academy of Sciences of Ukraine in Kiev, Kopchynskyy noted that this reactor bears no resemblance whatsoever to the one at Chernobyl. That type of accident simply cannot happen there, although it is undoubtedly necessary to maintain control over the reactor.

As far as the burial ground at Pirogovo is concerned, in Kopchynskyy's opinion the depository was built with out-of-date technology and it is already time to think about building a new one.

### **Chernobyl Legacy: Radiation Persists But Treatment Lags**

*93WN0138A Moscow ROSSIYSKIYE VESTI  
in Russian 23 Nov 92 p 4*

[Article: "Chernobyl's Imprint on Russia"]

[Excerpts] As of March 1992 radionuclide soil contamination with an average cesium-137 density of 1.0 curies/square kilometers or more was recorded in 15 of Russia's administrative territories: Bryansk (contamination of 34 percent of the oblast's area), Kaluga (17 percent), Belgorod (8 percent), Voronezh (1.5 percent), Kursk (4.4

percent), Leningrad (1 percent), Lipetsk (about 8 percent), Orel (40 percent), Penza (3 percent), Ryazan (15 percent), Smolensk (0.5 percent), Tambov (1.7 percent), Tula (47 percent), Ulyanovsk (0.6 percent), and Mor-dova (2 percent).

About 400,000 citizens who took part in eliminating the consequences of the accident at the ChAES [Chernobyl Nuclear Power Station] and were exposed to the radiation live in Russian territory. Illnesses of the blood circulatory system and the heart, vegeto-vascular distonia, hypertonia, and so on have been observed in them. In this situation, prophylactic medical examination for the population that was affected by Chernobyl should be conducted annually. However, in the past year, for example, only 65 percent of the residents of the southwestern parts of Bryansk Oblast who are subject to medical examination were inspected in the past year.

According to the data of S. Fetisov, a member of the RF [Russian Federation] VS [Supreme Soviet] Committee on Women's Affairs and Protection of the Family, Maternity, and Children, 78,000 children (5,000 of them less than a year old) live in the Bryansk area that was contaminated by radionuclides. The morbidity indicators for children from the contaminated regions also have exceeded the oblast average for five chief illnesses, among which are sicknesses of the endocrine system and the blood. [passage omitted]

The number 20 mkR/ch [microroentgens/hour] is considered the norm for the RF. A number of less than 0.1 ber/god [roentgen equivalent, mn/year] is safe for habitation. Resettlement begins when the indicators are more than 0.5 ber/god. These figures are not Greek to us. Each citizen can buy his own personal dosimeter and read its indications. In 3 years 28,500 people were resettled from contaminated regions of Bryansk Oblast. In all, during the post-accident period, 42,300 residents left voluntarily and were resettled, 900 people left Kaluga Oblast, where only voluntary resettlement occurred, and 5,000 people left Tula Oblast, where resettlement was not mandatory. Another 4,400 people should have been resettled involuntarily from Bryansk Oblast territory and it is planned that this will be done during the current year and the first half of next year. [passage omitted]

### **Shall Prosecutor Whitewash Radioactivity Spots?**

*927F0335B Moscow SPASENIYE in Russian  
No 31-32(46-47), Aug 92 pp 6*

[Article by Green Thread Information Agency]

[Text] New radioactivity spots of the Chernobyl provenance have been discovered on the Tambov oblast. In the past year, the number of leukemia cases in the oblast increased by 2.5 times. In the Morshansk rayon, two radioactive meat cases have been reported. Yet the money allocated by law for cleaning up after the Chernobyl accident has not yet begun to come in. The oblast prosecutor has registered his protest as a result.

**Nuclear Blackmail**

Construction of a network of small hydroelectric power plants with a total capacity of 500 kW has been abandoned in the Rostov oblast whereas the Rostov NPP is virtually ready for operation. In order to convince the oblast residents in the "superiority" of the NPP over the GES, they are periodically subjected to energy blackmail: for example, the lights are turned off.

**Moscow Scientists Prepare Design for Building Radioactive Waste Burial Site Novaya Zemlya**

927F0331B Moscow *RADIKAL* in Russian No 31, Aug 92 pp 9

[Article by Editorial Board]

[Text] Moscow scientists have prepared a design for building a radioactive waste burial site in Novaya Zemlya. Today, it is undergoing state examination which is carried out by experts from the Ministry of the Environment and Natural Resources and other Russian departments. In the opinion of Chief Radiologist of the Murmansk oblast A. Mikhaylov, "a first serious practical step has been taken toward solving the problem of permanent burial of dangerous waste". The design meets all principal IAEA specifications for such structures. In the experts' opinion, it ensures safe and virtually eternal radioactive waste burial. It is expected that the project will be made the subject of a wide-ranging public discussion, yet keeping in mind the highly negative attitude of the deputies of the Arkhangelsk oblast council to the very idea of building such an installation, the *Krasnaya zvezda* newspaper says that the last word is far from having been spoken.

**Shushkevich Criticized for Backing Nuclear Power Plant Construction**

93WN0135A Moscow *KOMSOMOLSKAYA PRAVDA* in Russian 19 Nov 92 p 2

[Report by O. Yegorova on round-table: "Is One Chernobyl Not Enough for Us?"]

[Text] *This dispute concerns everyone: whether there shall or shall not be nuclear power plants in Belarus.*

[Ye. Petryayev, professor]: After the return of Supreme Soviet Chairman Stanislav Shushkevich from the World Ecological Congress in Rio de Janeiro people heard for the first time since the Chernobyl catastrophe that it is necessary to develop nuclear power engineering in Belarus. Shushkevich stated officially that we must build at least two nuclear stations.

There was practically no public reaction to his statement. But now the "Life After Chernobyl" charitable fund, which I represent, has decided to publish the opinions of those in favor of nuclear power and those opposed; after all, this decision concerns not only us, but our children and grandchildren.

On what did Shushkevich base the need for nuclear power engineering in Belarus? First of all, the republic is poor in resources, and that means it has to depend on other CIS countries. Once we are power-dependent, we cannot be independent economically, nor politically.

Secondly—Chernobyl... It is true that an explosion occurred in a reactor; however, our reactors are poor. But you see, if one takes the modern western reactors, nuclear power is safe.

From my own viewpoint, neither conclusion, and there are others as well, can withstand serious criticism. And well, if we take the path to nuclear power engineering, will we really not have to depend on the supplier for the nuclear reactor itself, and for its fuel, and for radioactive waste disposal? Once again we fall into a state of dependence—and just as severe—but this time on Western nations. Secondly, Western nuclear reactors are safer than ours; but after all, the risk is there all the same...

Since the Chernobyl catastrophe Belarus has suffered damage equal to at least ten annual budgets. There are more than two million victims—one in every four persons, like in the Great Patriotic War... If one took the cost of all the electrical power generated by all the stations of the former Soviet Union during all its years of existence, it would still not be enough to cover the damage.

Even today one-fourth of our population is living in contaminated regions. It is impossible to imagine how the republic can survive: 28 percent of the budget every year is spent on Chernobyl matters; and for just how many decades will this continue to go on?...

[A. Kudelskiy, professor]: I do not believe that the power engineering program in Belarus has been thoroughly thought out. Too much here has not been considered. For example, expenditures for energy: they are about five times higher than common sense allows. For decades the republic has had industry foreign to it. We are producing tractors of a post-war model... And an unsuitable economy means unsuitable power engineering. Our thinking is still linked to centralized production alone. We are still "suppliers." We are still not trading.

I am a member of the nuclear society of the former USSR, and I was shaken: it turns out that we were developing nuclear energy without any concern for anything else, and were merely creating monster-projects. And the expenses for disposal of waste products exceeded the cost of construction and the income from their operation!

[A. Vecher, professor at Belarus State University]: By the year 2000, 64 reactors will have been put into operation. Fifty-four are being built, and 11 are in the planning stage. The tendency is such that no growth in nuclear power engineering installations will occur. Nevertheless, energy is needed and I would like to stress the advantages (and this idea is no less than 100 years old) of the so-called fuel [toplivnyy] elements. Experts affirm that



by the year 2010 the fuel element installation capacity will be on the order of 40 million kilowatts in Europe, and from 50 to 100 kilowatts in the United States. This proves that an alternative to nuclear power engineering exists, and a very convincing one.

We have this means in our republic, and it is not being utilized in all regions, to say the least; it is even purposely hushed up.

**[A. Stavrov, deputy director of the Center for Radiological Safety, Power Engineering and Environmental Protection]:** We are currently examining ways to develop the power engineering complex of Belarus. We are not rejecting, but are examining simultaneously the power supply, traditional power engineering, all alternative sources, and nuclear power engineering.

Now, when the question is one of the dependence of the fuel-to-power-engineering balance, one must understand one simple thing: only one kind of fuel—nuclear—permits purchasing the greatest amount of power to supply us for years to come, and not feeding a station "by the truckload" ["s koles"]. Moreover, does a great deal not depend on transshipment, and on fluctuation of market prices? The price of fuel resources is climbing, while at the same time the price of uranium is falling.

No one can deny the possibility of an accident at a power plant. We have just one possibility, but we are not realizing it—to prevent a discharge [vybros]. There is no such thing as an accident-free production process.

**[Inga Shmitz-Feuerhake, professor of physics, Germany]:** People would gladly forget the catastrophe at Chernobyl, but you see Western reactors are also unsafe. The 1979 accident in the United States proves this. It was not a Chernobyl, of course, but what happened was not supposed to have happened. To this day no one knows how much radioactive material was released. Like everywhere, the government tried to keep the information secret.

It is even more surprising to hear the one and only argument of the nuclear proponents of Belarus: the economic independence of the republic. There is no reasonable alternative, they say. These are the very same arguments which in the West, in France for example, have become the basis of the state power engineering program. It is well-known that France utilizes 70 percent nuclear energy; but this program was adopted after 1973, after the so-called petroleum shock. Economists right now are in doubt of how to emerge from the nuclear shock.

**[Andreas Zeifert, sociologist, Germany]:** I read an article in DER SPIEGEL with amazement, in which one well-known manager unequivocally stated that the nuclear programs were certainly not conducted by the economists, but by the politicians. Their calculations do not consider the cost of development, nor the cost of storage;

nor, it goes without saying, the cost of eliminating the after-effects of possible accidents.

We believe that the most important source is the economy. The demand for energy is not a constant as they are trying to depict it here. It is necessary to lower this constant.

And I do not understand how this can be: we are now building a children's center for victims of the catastrophe, while 200 kilometers away, it suddenly appears likely that a new reactor will be built...

**[A Volkov, People's Deputy of the Republic of Belarus]:** As a member of parliament I am a member of the parliamentary commission on Chernobyl; as a scientist I am director of an international radiation center, and I am currently preparing materials for Strasbourg, for the European Parliament. I will be reporting all the information on Chernobyl, beginning with the discharges and ending with the health of the children.

This I can assure you: there will never be nuclear power stations in Belarus. Shushkevich will never get that far. After all, he has just delivered a report in Rio de Janeiro on children with cancer of the thyroid gland. And to speak of new reactors just a few days later?

How much did the Chernobyl tragedy cost? I have made the following calculations: 484 billion dollars to the former Union; to Russia, 174 billion; to Ukraine, 138; to Belarus, 171 billion. Just what does this mean? Russia, with her present budget, could pay this off in eight years; Ukraine, in 28 years; but Belarus would take 171 years! But how can one live without a budget? Where are we to get those 171 years?

I have been working in the zone for 6 years, and have covered it far and wide. I know the tragedy of my people. I will never forget what one middle-aged peasant woman said to me: "We can live here in the radiation. But there are no children's voices around us..."

#### **Krasnoyarsk GES Thins Yenisey Ice, Creates 'Chemical Fogs'**

93WN0023A Moscow IZVESTIYA in Russian 7 Oct 92 Morning Edition p 2

[Article by Aleksey Tarasov: "Those That Unfroze the Yenisey Should Freeze It"]

[Text] Having built the Krasnoyarsk GES [hydroelectric power plant], we are reaping the fruits: In winter the river does not freeze over hundreds of versts. The constant fog due to this absorbs the technogenic waste in the kray center and the residents of a city of almost 1 million breathe the crystal particles—complexes of carcinogenic substances. On the average, the number of diseases connected with respiratory tracts in Krasnoyarsk is 2.5-fold higher than in Russia.

This has been the case for many years. September comes and the city on the Yenisey is again in a dense fog. And



again journalists are gathered at a press conference in order to present the next idea for freezing the river. There has already been a great number of them. Older colleagues recall how P. Fedirko, first secretary of the party kraykom [kray party committee], demonstrated a model of one of the technical solutions of the problem to them. Only nothing has changed and the world surrounding the people of Krasnoyarsk remains topsyturvy: The Great Russian river has ceased to be a provider and during a sharp frost it flows as though it were summer and in summer it is impossible to enter it—it is only +4°C. One of the springboards for an ecological disaster?

Scientists and engineers, finding, in their opinion, a method of binding the Yenisey with a coat of ice, today agonize over the following question: Where to get the money for the realization of this idea? However, the planners of the Krasnoyarsk GES, who have committed such a "negligible" mistake in calculations—the Yenisey freezes 350 km, not 30 km, after the dam—feel absolutely not implicated in the kray's ecological troubles. At a press conference they cited the answer of Gosenergo to the question by the Krasnoyarsk municipal council: The existing evaluations of the effect of open reservoirs on the ecology of adjoining territories are of a purely emotional nature. In brief, wiggling out of this by hook or by crook, power engineering workers do not feel like debtors to the people of Krasnoyarsk.

Everything seems to indicate that the kray is left with one of two things: Either to bring a suit against the all-powerful department and to exact the sum necessary for the realization of the project—as compensation for the damage done to people's health (Siberians have recently become familiar with this practice—in August our newspaper reported on the suit of many millions of rubles brought by the people of Krasnoyarsk against nuclear scientists)—or to demand the transfer of the GES to municipal ownership. This idea was heard at the press conference held within the walls of the kray administration—Moscow receives income from the operation of the GES, but Krasnoyarsk is left with fogs swelling with chemical substances. Well then, the realization, for example, of the last plan of those presented to the press will require the receipt of instruments of payment from GES operation during only one month.

Furthermore, the Sayano-Shushenskaya GES—also a "miracle of hydraulic engineering"—is located higher up the Yenisey. Recently, with reference to Moscow engineer P. Khlopenkov, reports have appeared in the press to the effect that, if one of the annual Yenisey floods is much stronger than usual, the dam of the Sayano-Shushenskaya Station can be destroyed and a 200-meter wave with the speed of an express train will wash away every living thing downstream—not only Krasnoyarsk, but also the nuclear city of Krasnoyarsk-26. I omit the arguments and evaluations of the justifiability of such a conclusion. Why does the Ministry of Fuel and Power in

no way comment on this and other similar reports? Why is the spiritual peace of the residents of the Yenisey region of no value to it?

### **International Seminar on Nuclear Accidents Held in Kiev**

*WS1910133692 Kiev BUSINESS UKRAYINA  
in Ukrainian No 39, Oct 92 p 2*

[Text] An international seminar devoted to accidents at nuclear power stations was held 29 September through 2 October in Pushcha-Voditsa, near Kiev. It is this type of accident that occurred in April, 1986, in Chernobyl. This fact influenced the selection of the venue for the conference which was organized by the Ukrainian State Nuclear Board, the French Nuclear Association, and the Ukrainian Nuclear Energy Office. Specialists from Germany, Russia, Finland, Czechoslovakia, and some other European countries also took part in the conference.

"The idea of such a conference came from the Ukrainian side," said Georgiy Kopchynskiy, first deputy director of the Ukrainian State Nuclear Board. "France has accumulated great experience in the use of nuclear energy, which will be useful for our specialists. The objective of the conference is the prevention of nuclear plant accidents as well as the study of security issues based on emergency cases of RBMK and VVR types of reactors. On their visit to Chernobyl, the participants acquainted themselves with the progress of work aimed at the closure of all units in 1993 and directed by the Supreme Council and the Ukrainian Government."

"We, in turn, are interested in the experience of Ukrainian atomic specialists in the liquidation of the consequences of the Chernobyl melt down," adds the chief nuclear security inspector from Electricite de France, Pierre Tanguy, the leader of the French delegation. "This kind of accident is just impossible in France, and nuclear power engineering enjoys everyone's confidence. At present, our 55 nuclear power stations produce three-fourths of the electricity consumed in the entire country. We keep improving the power plant equipment and are working together with German specialists on new-generation reactors."

Michelle Otrique, branch director of Isfakhan Company of France, cited an interesting fact.

"A week before my trip to Ukraine, I watched the program about Chernobyl on French television," he said. "My friends and I wanted to get a "backyard" look at its creation. And what would you think? It turned out that it had been filmed someplace in Kazakhstan. Different kinds of horrors that never occurred in Ukraine were shown. We need true, reliable information about what measures are taken to ensure security at the nuclear power plants, what are the future prospects for this very important industry, what new experience has been accumulated by the world."

### On Radiation in the Environment

927F0331G Kiev PRAVDA UKRAINY in Russian  
29 Aug 92 pp 1

[Article by Editorial Board]

[Text] The republican center for monitoring the environmental conditions at the Ukrainian State Meteorological Committee reports that the radiation background is as follows: 11-12 $\mu$ R/h in Kiev, 13 in Zhitomir, and 15 in Chernigov which does not exceed the natural background level.

### Plowing Cesium

927F0331E Kiev PRAVDA UKRAINY in Russian,  
21 Aug 92 pp 2

[Article by Viktor Mazanyy]

[Text] The usual plowing of natural grasslands and the development of planted grasslands in their place will make it possible to limit the access of radionuclides to animal feed. This is the conclusion of the experts from the Rovno radiology center set up at the Sarny scientific research station. An experiment conducted there reveals that the movement of radionuclides from the topsoil into a deeper layer with a plow will make it possible to lower the cesium-137 concentration in plants by, e.g., two to threefold. And combined with agricultural chemical techniques, this operation will make it possible to attain an even better result.

According to the director of the Dubrovitsa reference station at the center Stanislav Syaskiy, "unfortunately not all experts from the enterprises whose territory is contaminated by Chernobyl understand this evident fact". Of course, the kolkhoz and sovkhoz cattle are grazing in cultivated meadows while private cattle in natural meadows. And that's where the concentration of harmful substances is the highest—they have settled in the sod. Our data show: the milk produced at such estates is contaminated by 5-10 times more than milk produced at collective farms. It is too bad that enterprise leaders are not in a hurry to allocate cultivated grazing lands to the private sector.

Today, station scientists are carrying out experiments in all regions over which the Chernobyl cloud passed. One of the most important discoveries of recent times was establishing the ability of the Timofeyevka field grass, which is the most common to the Ukrainian woodlands, to "repel" radionuclides. In the scientists' opinion, it must become the foremost crop among those used in cultivated pastures.

### Conference on Ecological Instruments, Clean Production,

927F0335C Moscow SPASENIYE in Russian No  
31-32(46-47), Aug 92 pp 6

[Article by V. Golubev, Scientific Secretary of the Conference: "Science, Industry, Market: Feedback"]

[Text] A scientific and technical conference on biomedical and ecological instrument making has concluded in Ryazan. It was sponsored by the Scientific Technical Society of Radio Engineering, Electronics and Communications imeni A.S. Popov, Ryazan Radio Electronic Institute, and Ryazan's production and commercial corporation "trading town..."

The goal of the conference is to develop a hexagon of closed activity between the development of environmentally clean productions and monitoring of the cleanness level with the help of radio electronic devices. On the other hand, an attempt is made to find an interaction among science, industry, and the market while realizing their joint production. Since the contamination of the habitat leads to an increase in many chronic diseases, the task of medical instrument building is reduced to developing new biomedical instruments. They can be used to monitor the health of large population groups. The chairman of the conference, Doctor of Biological Sciences V. Manusadzhyan developed this concept of interaction among medicine, environmental science, and instrument engineering in his report.

Doctor of Biological Sciences V. Lishchuk presented a somewhat different outlook on the development of biomedical engineering. In his "health strategy" concept, the leading role is assigned to the information and intellectual sphere. Here, the development of computer technologies and systems for monitoring and assessing the creative capabilities and mental processes is especially significant. Likewise, the assessment criteria of public health, especially the mental health (in addition to the physical, hygienic, etc.) determine the interrelation and correlation of our efforts in the spheres of ecology, medical engineering, and commerce. The author focused attention on the issue of competitiveness of the instruments under design, systems, and intelligent computer technologies in the international market which is the prerequisite for a realistic and efficient policy in the area of environment and public health.

V. Nasledkov presented an interesting and useful trend in the methodology of biomedical engineering. Implementation of medical r/z [expansion not given] and the increasing utilization of equipment in medicine makes it necessary to introduce the concept of bioethics, i.e., the possibility of interference of scientific and technical activity into the biological sphere of man and the living world. Organ transplants, artificial organs, artificial insemination... all these problems raise the issue of the ethics of the interference in the biology of living creatures while its level should be decided upon by the scientific community allowing for the principles of humanism and the survival of the fittest in nature.

At the medical section, V. Golubev presented a new procedure for examining the mechanism of thought formation with the help of a digital reverberation unit. It is shown that the thought present in the consciousness is formed by a continuous closed stream of pulses between the engram of the cortex and the small engram of the

thalamus. Consciousness, however, is a dynamic process of exchange of pulses between the homunculi in the cortex and the thalamus.

V. Golubev's report about introduction of square-law taxation for air pollution by automotive transport aroused raging debates (see *Spaseniye* of 9-10 March 1992). Only introduction of an automobile tax proportionate to the square of the fuel consumed by it would make it possible to equalize the economic expediency of shipping cargo by automobiles and the level of economic contamination. Without this law, the environment will continue to deteriorate and all talk about it will be nothing but idle chatter and mere noise.

There was a discussion on the issue of the functional dependence and real time during which the law may be implemented. Yet this depends on the growth of environmental organizations both here in this country and abroad and on their effect on the legislative power.

Reports on biotechnology should be recorded as insignificant and weak. They did not take into account the environmental requirements and were detached from the urgent requirements of today. It is necessary to set up regional zones for the microflora and fauna where conditions would be created for the self-cleaning of the contaminated environment due to this flora. Many reports were presented at this section, including those reporting advances in biotechnology yet unfortunately, nothing important about present and urgent problems and things which must be solved specifically was said.

### Environmentally Clean Energy Complex Urged

927F0335A Moscow SPASENIYE in Russian No 31-32(46-47), Aug 92 pp 6

[Article by Valeriy Firsov, Yalta: "I Came To Give You the Gift of Energy ..."]

[Text] From *Spaseniye*:

On 26 March of this year, Mr. Ye. Gaydar signed an order, (for some reason, on the stationery of the Chief of Staff of the Russian Federation Government. Could it be for conspiracy's sake?) about renewing the design and construction work at 12 nuclear power plants (AES). These include the commissioning of a high-power pressure-tube reactor (RBMK) at the Kursk NPP in 1994 and another one of the same kind that blew up at Chernobyl. And for all the "atomic" program in the first quarter alone (and after the fact), the acting prime minister allocated no less than 793.8 rubles! Who and what is behind it, our newspaper already suggested in Nos. 33-34 (in May of this year). We shall not repeat ourselves. And here is what one of our readers suggests as an alternative, and it would make sense for both Mr. Gaydar himself and the nuclear lobby in the Government and Parliament to ponder it. Or you can switch these bodies around depending on their ambition, yet it would not make any difference.

The nuclear scientists are continuing to intoxicate the peoples of the planet with an idea of the allegedly cheapest and ecologically purest nuclear power.

### Facts and Nothing But Facts

But let us analyze this.

The tombs and the burial sites of spent graphite rods are time bombs. They're capable of exploding within 10 years and result in radiation releases of a corresponding intensity. This is illustrated by a waste explosion for "inexplicable" reasons in the Chelyabinsk oblast...

Uranium waste will affect the atmosphere for at least 10,000 years, i.e., longer than the life of civilization.

In the next 15 years, 360 reactors will be out of commission due to "old age". When a power plant is decommissioned, this results in an average of 50,000 cubic meters of contaminated runoff which is 70 times greater than the volume annually accumulated in the storage facilities of operating reactors in the entire world. Cooling down one reactor would cost from 175 to 750 million dollars at a time while the cost of taking out of operation nuclear plants that have outlived their life would cost 63-270 billion dollars...

Expenditures for cleaning up the consequences of an emergency at only the fourth generating unit of the Chernobyl NPP will exceed 200 billion rubles by 2000 (before adjusting for inflation).

An examination of a million women who became pregnant after the Chernobyl accident shows that more than 120,000 of mothers gave birth to children with damaged genetics and immune protection (mental retardation, degenerates, and even mutants). So how could this have been cheap and clean energy?

Atomic energy may become the energy of the future if NPPs are absolutely waste-free and safe in operation. There is no third alternative!

### It Is Not Worth It To Use Bank Notes as Fuel

Today, the greatest danger threatening the existence of mankind is the constantly rising contamination of the planet with radioactive substances.

Let us consider the situation in the power industry in our country (data for 1990) as a whole. Electric energy production in 1990 was expected to be 1,860 billion kWh including 390 billion kWh at NPPs, 244 kWh at hydroelectric power plants (GES), and 1,225 kWh at thermal power plants (TES).

Everything is clear with nuclear power.

Hydroelectric power plants are the only structures which use renewable and almost environmentally clean energy. Yet so many flat plain meadows, fields, forests, and villages which become flooded are destroyed; an unfavorable microclimate is created in reservoirs and fish are destroyed.

The principal load falls on the shoulder of thermal power plants. Even Mendeleyev wrote that to use oil as fuel is the same as burning bank notes. And we proudly declare that our largest thermal electric power plant (TETs) consumes more than 30,000 tons of coal a day while forgetting at the same time to boast how much radioactive fallout is precipitated with the soot and how many acid and alkaline rains fall.

The standard for electric power consumption to mine one ton of coal underground is 51.9 kWh while in the central Donbass region it reaches 200 kWh. Altogether, electric power consumption for coal mining has been determined to equal 28-29 billion kWh.

Electric power consumption to pump one ton of crude oil and gas condensate is 75 kWh.

Outlays to transport coal and petroleum products, crush the coal, and prepare the slurry are about 100 billion kWh.

Two thirds of the energy of the fuel burned by thermal power plants is carried out with warm waste water. This is more than the annual runoff of the Volga river.

Every year, we lose more than 250 billion tons of equivalent fuel in the power industry. This greatly exceeds the annual output of the largest coal basin in the CIS—the Donbass.

#### **Eureka!**

For years I have been developing an energy complex utilizing the energy of storm and surf as well as sun, wind, and potential difference. This makes it possible to get rid of the "peak hours" concept in power engineering. And utilize the generated electric power fully, since the "slack" energy which is not simply being lost will be used together with excess electric power for decomposing sea water (contaminated with hydrogen sulphite) into hydrogen and oxygen by the electrolysis method.

Due to the fact that the electric power produced from the wind, sun, and storms is a one-time phenomenon and can be utilized for heating water or operating mechanisms only when there is wind, sun, or a storm, it cannot be plugged into the consolidated power system.

But can we be independent of the whims of nature? Yes we can! By burning hydrogen obtained due to the "slack" energy in oxygen, we attain a temperature of 2,800° and chemically pure water (H<sub>2</sub>O). Yet the maximum seawater temperature in the summer is 26°. Consequently, due to the potential difference we can obtain the necessary amount of electric power at any time. Thus, by using five types of environmentally clean and renewable energy we can substitute existing power plants and cease destroying the planet.

In the regions where there is no sea but there are nonfreezing reservoirs, one can increase the capacity of

existing TETs by a minimum of 30% and decrease the fuel consumption by 30% while producing chemically pure water.

Subsequently, we will be able to fully switch TETs to producing environmentally clean electric power.

#### **Specifically. More Specifically!**

Let us now calculate the impact of the proposed energy complex: the use of only environmentally clean and renewable types of energy;

a drastic decrease (up to 50%) in electric power outlays by fully giving up the destruction of coal, gas, and petroleum products in the TETs furnaces and boiler rooms. This will make it possible to cut back their production and use them only in chemical industries;

eliminating the concept of "peak hours" and "slack" and utilizing the generated electric power almost completely;

using excess and "slack" energy for producing hydrogen and oxygen in the necessary amount (where chemically pure water is a secondary product). This makes it possible to do away with hydrogen, oxygen, and distilled water producing plants, and, correspondingly, reduce the electric power demand;

the processing of seawater contaminated with hydrogen sulphide will make it possible to avoid spending billions for the proposed installations for saving the Black Sea. It is necessary to lower the pipe deep under water and pump in the "bed water";

construction of both small energy complexes and giants of the industry will make it possible to activate all 12 existing substations in greater Yalta as well as electric power transmission lines;

production of the necessary amount of electric energy will make Crimea not only a user of electric power but also its supplier to other regions over existing power lines (LEP);

the availability of the necessary electric power will make it possible to give up boiler rooms almost completely. By retrofitting existing heating systems into individual systems in residential and business buildings with the help of electric heat pumps it is possible to efficiently utilize heating in each individual case. In this case there is no longer a need for heat channels. Finally, the "geysers" will stop gushing from underground. It will be possible to save hundreds of thousands of kilometers of pipes of various diameters;

substitution of regular water with chemically pure water in heating systems will make the radiator and tubes almost eternal since there will be no more scale; and

there will be no need to ship coal and transport gas and petroleum products as a fuel, thus freeing up vast quantities of cars. Electric power and vehicles for shipping will be saved.



Finally, the energy complex also solves the problem of transferring urban transport to electric traction while the use of hydrogen and oxygen in automotive, marine transport, and aviation engines will make it possible in the shortest time to restore clean air not only in the cities but also, in particular, in the Yalta resort.

People with nothing else to do have calculated that the Crimea is forced to pay for the Dnepr water contaminated with radionuclides, pesticides, herbicides, heavy metals, etc., more than 3 billion dollars a year... Perhaps, the time has come to give it up and sell chemically pure water from the Crimea since there is enough drinking water in the Crimea even if its population increases by tenfold and there will be plenty of the purest service water. By irrigating saline lands in the western and eastern Crimea with pure water we will turn them into arable lands and, therefore, address the issue of finding homes for the Crimean Tatars, Germans, Greeks, and peoples of other ethnic backgrounds.

The design and construction of the first experimental commercial energy complex may be completed by the end of 1993 if the CIS governments approve of the initiative.

#### And Finally...

A patent examination at the All-Unions Scientific Research Institute of State Patent Expert Examination decided on 19 February 1992 that my invention claim is patentable and decided to grant a patent; furthermore, two inventions have been prepared for patenting under an international claim to the RST.

An Ekomir small enterprise was set up in Yalta and is carrying out scientific and research developments and exploratory work and is preparing a mathematical model of the complex; yet since the invention is original and the equipment is unique, it is necessary to sign agreements with a number of scientific research institutes as well as secure orders for making the equipment.

Tentative agreements have largely been concluded and commissioning of the first complex is still realistic for the end of the next year but will call for considerable financial outlays.

Consequently, I am appealing to the people of goodwill, benefactors, and sponsors and all those who care about the fate of the planet and the health of their children and grandchildren to take my call and help build an environmentally clean energy complex. Money can be sent to the following address: Yalta, MFO 324720, Yalta Branch of the State Committee of the Ukrainian Industrial Construction Bank, Account No. 1468926. You can receive answers to any questions by calling the following number: 32-45-28.

#### Nuclear Power Plants: We Say Kilowatts But We Mean Tons

927F0331C Kiev *RABOCHAYA GAZETA* in Russian, 3 Sep 92 pp 2

[Article by A. Kuznetsov]

[Text] During its operating life, the southern Ukrainian nuclear power plant supplied 100 billion kWh of electric energy to its users. Its first generating unit was commissioned in December 1982. Then one after another two more "millionaires" were brought on stream on the basis of VVER-1000 water-cooled water-moderated power reactors. Today, the nuclear power plant covers more than 90% of the electricity demand in the Odessa, Kherson, and Nikolayev oblasts. The value of the southern Ukrainian power plant is also high for the economy of Ukraine as a whole which is experiencing shortages of petroleum and products of its refining. In order to produce the same quantity of power which the NPP has already supplied in the 10 years of its operation, a thermal power plant would have to burn 30 million tons of fuel oil.

#### German Firms Compete for Contract on Chernobyl Replacement

AU1310125892 Kiev *URYADOVYY KURYER* in Ukrainian 2 Oct 92 p 11

[Information issued by Ukraine's Prime Minister's Press Service: "What Can Replace the Chernobyl Atomic Electric Power Plant?"]

[Text] As reported by Ukraine's Ministry of Energy and Electrification, a thermal electric power plant equipped with the most advanced steam-gas installations will be built in Chyhyryn [town in Cherkasy Oblast]. Its capacity will be almost two million kilowatts. It will replace the energy units of the Chernobyl Atomic Electric Power Plant.

The West German firms Siemens and ABB [Asea Brown Boveri] are competing for the right to build the plant.

#### Conference on Energy, Ecology Appeals to Russian Authorities

93WN0105A Moscow *RABOCHAYA TRIBUNA* in Russian 3 Nov 92 p 1

[Article by Vitaliy Lebedenko: "Can Power Engineering Be Reconciled With Ecology?"]

[Excerpts] We all know about the dispute that has arisen between power engineering and ecology. Mankind is beginning to reap the toxic harvest of this dispute today. And in its search for solutions, its main question is this: Can power engineering be reconciled with ecology?

"It can! And all the more so this is something that must be done in the Far East!" believes Vitaliy Lebedenko, chairman of the Council of the international power

engineering association ADEKSO. To confirm his words, together with other interested organizations he convened power engineers and ecologists in Khabarovsk for an international conference, "Power Engineering and the Environment." [passage omitted]

This is what the participants of the conference had to say:

**To the Parliament and Government of Russia: An Appeal From Participants of the Conference 'Power Engineering and the Environment'**

Mankind faces a real danger of ecological catastrophe today in a time when appeals to save the environment from the destructive consequences of thoughtless economic activity are ringing ever clearer. Under these conditions, we, the representatives of the power engineering sector, together with ecologists, and with the participation of specialists from foreign countries, demonstrating unity of views on the problems of survival troubling us all, appeal to the parliament and government of Russia to do everything possible to attain a global objective—creating an ecologically healthy society.

The necessity of this appeal is dictated by the unique features of power engineering, which sometimes does irreparable harm to the planet's ecology. The "greenhouse effect," acid rain—such is nature's reaction to the work of human hands. Nor is the situation any better in Russia and other states of the former USSR. Pollution of the atmosphere and entire territories with the discharges of thermal power plants continues, and the natural balance in the vicinities of operating hydroelectric plants is being disturbed. The memory of Chernobyl is forcing people away from what would seem to be the most progressive form of energy—atomic. As a result several operating nuclear power plants are shutting down, and construction of new ones is being stopped.

That is the way things are today. But we are in a position to change things. If we say "no" to the bureaucratic approach that has reigned in the economy for many long years, if we cast off the emotions of protest rallies that deflect us from the real ecological problems. What we need today is the wisdom of scientifically verified decisions, competency and decisiveness in actions.

What we need to do first of all is to reach the understanding that further development of power engineering must proceed inseparably from solution of ecological problems. We need to break through to new technology, to a new level of safety of power production facilities, and mainly nuclear.

Russia has the necessary scientific and technical potential for such a breakthrough, it has the rich experience of practical power engineers, and it has the productive capacities of the largest and most highly respected enterprises. The priority objective is not to miss the chance today offers, not to put things off until tomorrow, to get to work. These problems are especially urgent in the Far

East, where an unfavorable power engineering and ecological situation has evolved. If we do not take immediate steps here, we will place the work of the enterprises, the living conditions of the people and the nature of the region in jeopardy.

We must invest greater assets and scientific and technical potential into the development of safe energy sources. Besides hydroelectric power plants, such facilities include plants operating off of nuclear fuel. It is to them that we should give priority in the development of power engineering, especially in Russia's Far East, to a reasonable combination of facilities of traditional and nontraditional power engineering equipped with the progressive production processes.

Such is the unanimous opinion reached following analysis of the situation by participants of the conference—power engineers and ecologists of Russia, Belarus and Ukraine, and representatives of France's Electricite de France, the Japanese nuclear industrial forum and other foreign specialists.

We need a state program supporting power engineering. It will provide a possibility for initiating construction of plants equipped with progressive production processes, as well as nuclear power plants of a new generation with safer reactors; it will help us coordinate the activities of many sectors of the national economy, and introduce a system of privileges for regions developing nuclear power engineering.

We are certain that atomic energy has a great future. But it is impossible without coordinated, purposeful actions of legislators, business people and the entire society.

We need to adopt a package of laws as soon as possible in the area of atomic energy having the purpose of defining the legal basis and principles of public relations in the use of atomic energy, protecting the health and life of people and the environment, and encouraging the participation of citizens, public associations and interested organizations in establishing state policy regarding the use of atomic energy. [passage omitted]

**Nuclear Power Plants Are Saving Foreign Exchange for Ukraine**

927F0305E Kiev PRAVDA UKRAINY in Russian  
18 Aug 92 p 2

[Text] In an interview to the largest newspaper in Nikolayev, the YUZHNYAYA PRAVDA, the chairman of the board of directors of the Ukrainian Nuclear Power Industry Concern and the director general of the Southern Ukrainian Nuclear Power Plant Association Vladimir Fuks stated that as a result of the withdrawal of appropriations for the construction of all nuclear power plants, billions of rubles worth of equipment has been abandoned. Such a decision could hardly be justified in the government of laws.

Speaking about a recent meeting with the Ukrainian president, V. Fuks reiterated that the following issues were emphasized: the national energy program must be developed by incorporating world and domestic experience, and the nuclear power industry must become its integral part. Moreover, the nuclear power plants must be reliable and safe. To this end, specific government action aimed at upgrading and increasing the technical level of the plants is necessary. In the world of the economist, the role of the nuclear power industry in Ukraine under the conditions of an acute energy shortage is increasing and will enable the state to save foreign exchange necessary for purchasing bread.

### Who Will Buy Nuclear Power Plants?

927F0331A Moscow *RADIKAL* in Russian No 31, Aug 92 pp 11

[Article by Yuriy Titov, Kharkov oblast state administration, "Delovoy mir" Southern Journalism Agency]

[Text] The PHB Central Europe Limited Company (Washington and London) has prepared proposals for prioritizing the Ukrainian electric power industry.

Yuriy Titov, Deputy Chairman of the Kharhov Oblast State Administration comments on this fact.

Even the most indefatigable defendants of private property understand that there are branches of the economy to which privatization is contraindicated. The power industry belongs to that group. In any of the divestment and privatization programs existing in the Ukrainian regions, there is not even a hint of changing the form of property when it comes to the power industry.

Nevertheless, the ministry of power industry and electrification of Ukraine ordered and received from the PHB Central Europe Limited Company (Washington and London) proposals for organizing a transition period to market mechanisms and privatizing the electrical power industry in Ukraine.

The inevitable approach of an energy shortage in daily life is not yet felt, but at enterprises, disruptions in energy supplies are not new and happen with an increasing frequency, become longer, and are increasingly harmful for production. And there are many serious reasons for this. Until a certain time, everything in our national economy had an outlook for the future only if it had been planned for many years ahead. Thus, the power industry was expected to develop in strict correspondence with a national program which did not presuppose upgrading or building large thermal power plants in the European part of the USSR—reliance was placed upon nuclear power plants (AES).

After the Chernobyl catastrophe, the existing program essentially collapsed. In the evolving situation, it would be nice to regroup and shift vast resources from nuclear power plants to thermal. Yet the time was lost and soon the matter was placed on the back burner completely: the

carving out of what was left from the collapsing Union was underway. Ukraine ended up with a number of nuclear power plants which were completed by the builders but not put in operation and they will not be commissioned since the Parliament has decided to terminate NPP construction in the Republic. Ukraine was also in an unenviable situation for another reason: the energy producers in the Republic are the thermal power plants more than half of which were erected several decades ago and which have simultaneously exhausted their design life already.

What does this portend? For illustration, let us look at the Kharkov region which has a total energy capacity of 4 million KW give or take a few. Three quarters of it falls at the Zmiyevka regional state power plant (GRES) whose workers are even today proud of an unusual efficiency indicator better than anywhere in the world (82%). Yet everything here rests primarily on a high skill level which can carry you through only until the equipment wears out irreparably.

We cannot expect that Ukraine will become so rich that it will be able to allocate resources for carrying out a national power industry development program. We also cannot resort to the old habit of "patching up". We need a completely new and nontraditional approach to immediate reorganization of the industry.

In Great Britain, until quite recently all of the power industry was the property of the state which had a complete monopoly on the sphere of energy supply and was experiencing so many problems with the industry that the well-known English conservatism finally couldn't tolerate it any longer: a transformation of state property into private began in the power industry and the monopoly was replaced by free competition. A trend toward demonopolizing the electric power branches of the industry is also clearly visible in Japan, Germany, Italy, France, Denmark, and The Netherlands; most of the enterprises and at times all of them are becoming private property.

In America, independent power companies are building power plants with expenditures 30% below those incurred by electricity-generating monopolies and do so within a shorter time, employing 40% less of specialized service personnel than the monopolies. Prior to the radical transformations in the British electrical system, the monopoly company was planning construction of four large NPPs and two coal-burning power plants. The reorganization and development of two competing companies led to the emergence of an energy market and then to a reevaluation of the plans. As a result, preference was given to a gas-burning plant and this measure alone without all other factors made it possible to lower the electrical power plant construction by almost a quarter compared to what it would have been otherwise.

Reorganization and privatization in the electric power industry lead to a considerable decrease in expenditures which should be of special interest and attraction to us.

PHB Central Europe Limited submitted specific plans on how to cope with two problems. The first is reorganizing the Ukrainian power industry in such a way so as to enable it to operate efficiently under market conditions and enable the market mechanisms to be effective within the industry itself. The second is to train power industry workers for the impending privatization in accordance with government policy.

We should especially emphasize that the British and American experts do not recommend that we start with privatization. The most important thing is first to organize competition and only then sell the energy complexes into private hands. Otherwise, the power industry may lose the existing technical level while the fractured private companies will not be able to organize efficient energy transfers.

Plans call for setting up independent stock companies on the basis of such structures as the energy ministry, auxiliary electric power production enterprises, and electricity supply and marketing enterprises. In the opinion of foreign experts, at least five companies should be operating in the electric power generation sphere. The inevitable competition among them will force the power workers to operate much more efficiently than before. Demonopolization is the best way of increasing the quality of consumer service. In the past 10 years, these types of changes in various forms have been tried and produced the expected results in many countries of the world.

All this is good but the power industry is a special case. Electric power cannot be added up, so a complete coordination of supply and demand is necessary every minute. In other words, without centralized control little good will come about. But we're talking not about control as such but about a system of central coordination or a dispatching control mechanism.

It is necessary to develop a central control room. This control room must provide energy to enterprises from any power plant selected by them. Indeed, each one will choose the cheapest yet then it will be necessary also to

pay for transmission. The freedom of electric power plant choice must be supported by legislation.

And what about the stations with a high cost of production? Who will buy electric power from them if there is a freedom of choice? The system calls for changing the electric power rates every half hour. The highest rate will be during the peak hours. During that time, virtually all stations will be profitable. During the night, only the stations with the lowest cost of production will be profitable. Thus, one of the most important laws of the market—if you want to increase profit, lower the cost of production—will be at work. And the user is highly interested in the low cost of production.

After auctioning off one or another enterprise, it will be possible to switch to its privatization using various methods. These include selling power companies to other stock companies or selling shares to small investors as well as participation of private companies in the market and construction of new facilities or even acquisition of old stations with their subsequent modernization; this also includes power companies selling their individual substations and setting up of joint ventures with foreign partners in order to build or upgrade power plants.

The foreign experts submitted a cogent and rather detailed program. Not long ago, the Ukrainian energy ministry collegium held a meeting which discussed the reorganization program in the power industry. The speakers admired the closed logical structure and flawless utilization of the market laws. Yet the logic of the market must operate in a market country while Ukraine is not yet such a country. For example, under market laws, the lower the installments received by the users, the higher the electric power rates. Yet in our country it is the opposite.

And if something from the market economy is transferred to our unclear type of economy, there will be many misunderstandings. In other words, a vicious circle is inevitable. Yet somehow it must be broken. Should the power industry become the first to do so?



### Status, Development Outlook, and Priority Scientific Practices in Power Industry Field

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[Article by G.N. Aleksandrov, L.V. Arsenyev, I.A. Gruzdev, V.A. Ivanov, G.M. Pavlov, M.P. Fedorov; UDC 620.9(1-773)]

[Text] The working conditions of the entire economy are changing under the effect of the transition period which our state has entered; in particular, the working conditions in the power industry are undergoing a significant change. Consequently, forecasting the dynamics of changing energy consumption and the principal factors which determine the development of the power industry and its problems in the short and long run are becoming one of the priority trends in scientific research.

The principal power industry development trends will be determined by the environmental problems, the issues of fuel supply (especially for the European part and the Far Eastern region), and the reliability and economic efficiency of the equipment. In this case, the issues of reliability and environment are moving to the foreground.

The problem of reliability is aggravated by the presence of a large number of units which have already outlived their design life or are approaching the end of it. Their total capacity which already exceeds 60 million kW is increasing by 80-10 million kW annually. Since the replacement of the entire pool of such equipment is unrealistic in the nearest future, the problem of prolonging its service life arises.

The principal ways of solving it are switching condensation power plants to combined production of the electric and thermal power and topping off steam turbine thermal power plants (TES) with gas turbine plants in order to convert TES into steam-gas units. There is a certain stock of completed research on hand in this direction. Thus, condensing units of TES with a total capacity of over 15 million kW have been switched to combined production of thermal and electric power. They cover more than 10% of thermal loads in the country. As a result of the transition, principally new types of turbine units have been produced—heat supply condensing and condensing heat supply units—whose properties have not yet been studied sufficiently. TES overhaul, an analysis of variable duty conditions and maneuvering characteristics, and the development of control systems represent one of the priority trends in scientific research and power engineering.

In order to solve the environmental problem, it is necessary to develop efforts in three directions: reducing discharges at operating TES by utilizing highly efficient

scrubbing devices; using new methods of fuel combustion which sharply decrease exhaust; and using "environmentally clean" energy generating units which eliminate ash and heavy metal discharges and utilize them in other branches of the national economy. A certain contribution to solving this problem can be made by the so-called nontraditional power industry plants—tidal, geothermal, solar, wind, etc.

Transition to extensive utilization of combined plants operating on natural gas and in the long run—on the products of the internal cycle solid fuel gasification—should become a serious step toward reducing fuel outlays. Here, the principal tasks are to select an efficient plant design and ensure high reliability of the gas turbine at high temperatures (up to 1,200-1,800°C) as well as varying operating condition of the steam-gas plant (PGU) and its automation.

**Heat Power Industry.** To a large extent, the combined plant indicators are determined by the level of initial gas temperature on the turbine inlet. Combined plants created on the basis of gas turbine units (GTU) with an initial gas temperature of up to 1,154°C are used abroad. In the United States, Japan, and Germany, GTUs with an initial gas temperature of 1,260-1,280°C are being used. Combined plants on their basis will ensure an ISO efficiency (KPD) level of 51.5-52.0%.

The initial gas temperature level in domestic stationary GTUs is noticeably lower. The development of a high-temperature gas turbine is one of the central issues of the country's power industry at large. Today, the issue of developing a new generation of gas turbines capable of operating at gas temperatures of 1,150-1,260°C is being addressed. Subsequent plans call for increasing the gas temperature to 1,400-1,500°C. Such high temperatures could be mastered by improving the gas turbine cooling systems. To this end, steam will be used as the heat transfer agent of the gas turbine cooling system. This will make it possible to increase the initial gas temperature by 150-200°C or even by 275-315°C according to foreign data compared to the best air cooling systems.

Completed research demonstrates that in specialized combined units efficiently utilizing the heat removed during the gas turbine heating, an efficiency of more than 60% can be attained in the steam circuit at an initial gas temperature of 1,500°C.

In order to ensure such high thermal efficiency, it will be necessary to develop the scientific principles for optimizing the thermal design of the combined plant and select an efficient level of its working media of parameters. In so doing, it is necessary to take into account the possibilities of using the combined plant not only in the condensation but also in the heat supply mode. A high-efficiency combined plant calls for developing a method of designing its varying duties and analyzing them and then developing the concept of controlling this plant on this basis.

At gas temperatures of over 1,200°C, the issue of gas turbine reliability becomes especially urgent; a complex of both theoretical and experimental research aimed at developing highly efficient cooling systems of the turbine setting is necessary for addressing it.

One of the trends of increasing the GTU indicators is using new ceramic materials. Ceramics are used in turbine engineering as a material possessing exceptional properties—high-temperature resistance, erosion and corrosion resistance, and low density. New design principles must be employed for efficient utilization of ceramics.

The experience of designing high-temperature ceramic turbines by nontraditional methods accumulated in recent years shows that in the next five years a domestic ceramic engine (KD) with a 50-5000 kW power whose efficiency is at least equal to that of a similar class of internal combustion engines (DVS) can be developed in the next 5 years. Subsequently, such an engine could be used as a module for a powerful power plant.

The use of ceramics will make it possible sharply to increase the initial gas temperature and total engine efficiency especially in the case where the waste gas heat is recovered as well as attain an efficiency of 42% or more. In the long run, a ceramic engine contained within a steam-gas plant (GPU) will make it possible to attain an efficiency of the entire combined plant of over 60%.

The aforementioned tentative efficiency figures confirm rather convincingly the high value of ceramic engines in the power industry of the future as environmentally the most perfect thermal engines.

In recent years, considerable success has been achieved in the field of developing principally new ceramic engines—ceramic combustion chambers and high-temperature small-size axial and radial flow gas turbines—at a number of organizations (at the All-Union Scientific Institute of Power Industry, the Plant imeni Klimov, etc.). In order to complete the theoretical, experimental, and design developments already underway, it would be quite expedient to formulate and finance a minimum number of works which would ensure the fastest stage-by-stage implementation of ceramic engines for various purposes at varying degrees of ceramic element utilization as a function of achievements in the field of ceramic material development from state budget resources on a competitive basis.

The planned scale of high-temperature GTU implementation in the power industry and transport aggravate the problem of environmental contamination, primarily with nitrous oxides ( $\text{NO}_x$ ). Its solution calls for research aimed at developing low-toxicity combustion chambers using advanced fuel combustion methods.

Powerful steam-turbine units with supercritical steam conditions reaching a high level of perfection are the backbone of modern power engineering. Yet the problem of further increasing the initial steam conditions and

complicating the thermal design remains acute; this will call for considerable outlays not only for scientific research but also for the production base. Research aimed at increasing the reliability of modern units remains urgent. Here, it is first of all necessary to note the development of the methods of erosion-corrosion protection of the steam turbine setting not only for fossil but also for nuclear fuel.

One of the problems in today's power engineering is the constantly the deteriorating fuel quality due to the exhaustion of many mineral deposits and use of low-grade fuels and fuels with a high concentration of non-combustible matter. Substitution of design fuel with other fuels leads to a decrease in the technical and economic indicators and the reliability and readiness of the equipment to pick up the full load.

An analysis of the fuel combustion processes shows that many of these problems can be solved by using new fuel process organization principles at low-temperature combustion conditions and multiple fuel particle circulation. In world practices, boilers with a circulating fluidized bed in which the maximum combustion process temperature does not exceed 850°C are widely used. This is not accompanied by slagging of the heating surfaces and decomposition of the mineral portion of the fuel, the formation of nitrous oxides is reduced sharply to a level which is considerably lower than the maximum permissible concentration, and sulphur oxide trapping due to additions of binding components to the circulating mass is facilitated. Yet boilers with the fluidized bed are quite sensitive to changes in the fuel quality. If the burnt fuel characteristics differ sharply, the furnace process is upset and all indicators, both economic and environmental, worsen. Consequently, boilers with a fluidized bed are not gaining wide usage in domestic power engineering.

A swirling-type low-temperature furnace in which the principle of multiple intrafurnace fuel particle circulation is combined with the low-temperature fuel combustion conditions is a version of a low-temperature furnace with multiple particle circulation. The principal distinction of this furnace from those with a fluidized bed is in the mass of the fuel present in the furnace. It exceeds the fuel rate per second by 10-30 times. Consequently, even considerable fluctuations in the fuel characteristics have little effect on the furnace process.

A decrease of the gas temperature at the furnace outlet and, consequently, of the flue gases increases the operating efficiency while low temperatures in the combustion zone combined with multiple particle circulation decrease the nitrous oxide and sulphur formation by 30-60%. An increase in the gold [sic] particle size increases the operating efficiency of the ash collectors leading to a decrease in the environmental contamination with dust discharges.

In addition to experimental efforts with new and upgraded furnaces, the assimilation of the new fuel

combustion technology must be accompanied by theoretical studies of the furnace processes, the processes of mineral ash content conversion, the processes of toxic component generation and suppression, and heat exchange under the conditions of elevated concentrations of the furnace medium components with different temperatures. Solution of these problems will make it possible to develop a technique for analyzing and designing multiple-fuel environmentally clean boiler plants.

In order to increase the economical operation, reliability, and performance properties, including the environmental indicators, of the power equipment, it is necessary to master new technology which is closely related to formulating the tasks of analyzing the working process at a qualitatively new level.

Developments in the direction of designing modern mathematical models and computation routines which describe the thermodynamic properties of single- and multi-component single- and multi-phase working media, hydro- and gas-dynamics, and convective heat and mass transfer at various flow conditions and the phenomena of heat setting and departures from nucleate boiling are rather important. Application software packages already developed are necessary for creating a new generation of high-temperature gas turbines, powerful steam-turbine and combined power plants, combustion chambers which ensure a low concentration of nitrous oxides in the gases discharged into the atmosphere, and high-voltage equipment with an elevated reliability.

The following tasks are foremost: creating new modern methods of analyzing the hydrodynamics and heat exchange in three-dimensional turbulent flows in channels with respect to the flow sections and cooling systems of powerful steam and gas turbines as well as cooling systems of large electric generators; developing versatile methods of analyzing the thermodynamic properties of multi-component gaseous and liquid media from known properties of pure components; developing a method of analyzing the operating processes in the evaporative film mixing systems of combustion chambers in gas turbines which ensure a considerable decrease in the harmful combustion products into the atmosphere; developing the methods of predicting the heat setting and departure from nucleate boiling phenomena in the layers of insulating fluids with respect to high-voltage electrical equipment.

Due to the complexity of the fuel supply situation in a number of regions in Russia, further development of nuclear power is necessary. New NPPs must be based upon a new generation of reactors with an elevated safety whose designs have already been developed. The principal problems in the operation of existing NPPs and those under design are due to ensuring the reliability and safety of the equipment, the need to bury radioactive waste, increasing the economic efficiency of NPPs, and decommissioning the reactors which have outlived their

design life. In order to solve one of the principal problems—the equipment reliability and safety—it is necessary to raise the operating culture and the level of generating unit automation using microprocessor control systems as well as widely utilize engineering diagnostics systems. Accelerated development of scientific research is necessary both for developing a new generation of reactors with field refinement of all systems and for creating the facilities and systems which ensure safety and reliability.

In the field of fusion power, the principal problem is creating a pilot fusion reactor. To this end, the following is necessary: to study the physical processes in high-temperature plasma in the reactors working chamber; to solve in practice the tasks of the tritium generation in the reactor blanket, its extraction from the lithium-helium mixture, plasma injection into the reactor working chamber, heating the plasma to fusion temperatures, and confining it during a time necessary for maintaining a stable fusion reaction and plasma diagnostics; it is also necessary to solve the engineering problems of developing the working chamber, the blanket (including the plutonium buildup from depleted uranium in hybrid reactors), the first wall, superconducting magnetic systems which ensure the plasma confinement, and other systems supporting the serviceability of the reactor as well as to select the system of the thermal power plant and create an automatic reactor control system. There is a set of alternative proposals in all of the directions and many of the physical problems have been solved although the solution of the main problem related to igniting the reaction still remains to be found.

Thus, the following can be regarded as priority trends in the development of scientific research: developing a trend for upgrading the existing electric power plants with replacement of obsolete and spent equipment while simultaneously addressing the tasks of increasing its economical efficiency, reliability, maneuverability, and environmental indicators; developing the stock of scientific research on hand necessary for mastering high-temperature GTUs both with efficient turbine part cooling systems and using ceramic materials; developing highly efficient combined plants with an efficiency of about 60% on the basis of high-temperature GTUs; developing a range of measures in order to increase the effectiveness, reliability, and maneuverability of powerful steam-turbine units; mastering new low-grade fuel combustion technologies on the basis of theoretical and experimental research into the furnace processes; developing new modern methods of analyzing the hydrodynamics and heat exchange in three-dimensional turbulent flows (including the nonstationary) in channels with respect to the flow sections and cooling systems of powerful steam and gas turbines as well as cooling systems for large electric generators; examining the hydrodynamics of flow sections as well as searching for new design versions of hydraulic turbine machines and units aimed at substantially increasing the environmental safety and economic efficiency; and developing



the methods and facilities for increasing the ecological safety of the power equipment.

**Hydroelectric Power.** The situation with hydroelectric power has changed dramatically in the past 5 years. For various reasons, construction of a number of hydroelectric power installations was terminated while most of the designs were rejected by expert examinations due to the insufficient social and environmental feasibility. Under these conditions, the need arose for reevaluating the principal approaches to the development of hydroelectric power and primarily to the scientific and design feasibility. Institutions of higher learning which carried out a series of exploratory research in new hydroelectric power development trends have played an important role in formulating a new scientific and technical policy.

As the first priority, principal attention was focused on the issue of solving the problem of environmental safety of hydroelectric power installations. In the structure of this problem which calls for immediate consideration a series of issues can be identified: the principles of forming natural man-made systems in hydraulic power engineering; the environmental aspects of the design feasibility of hydroelectric power plants; expert examination; and decision making.

In treating the preservation of the economic and social way of life of the indigenous population as a pivotal task, it is necessary to decrease the flooded land areas. Meeting the condition of ecological compatibility of the hydroelectric power plant with the natural environment may lead to giving up construction of a large power plant and replacing it with several lower-capacity power plants.

The development of hydroelectric power plants (GES) which are compatible with natural systems is a central task in developing the natural-manmade systems in hydraulic power engineering. This calls for analyzing the problematic environmental situations, and searching for ways of attaining the specified natural environment quality standards. The tasks of developing a regulatory base are very acute: evaluation criteria of the environmental impact of the energy technologies, the ecological capacity of the territory, the permissible boundaries of the manmade influence on the natural complexes, the critical state of the ecological systems, etc.

Today, it is necessary to develop new approaches to justifying the operating conditions of hydroelectric power installations. The functions of the computer-aided process control systems (ASUTP) being designed for monitoring the state of the natural environment and more fully taking into account the environmental and social requirements must also be expanded.

The stock of available research on hand in the following scientific research efforts which may find applications in industrial science exists in this area: ASUTP subsystems for brief and on-line control of the water-energy operating conditions of the GES cascades; GES and hydroelectric pumped storage power plant (GAES); ASUTP

subsystems for the intrastation control of the GES unit operation conditions; methods of multi-criterial ecological-energy feasibility of the operating conditions of GES, GES cascades, and power complexes (for IBM PCs); expert decision making systems for controlling the installations of hydraulic engineering complexes in environmentally dangerous situations (multiple releases of contaminating agents); natural environment monitoring systems in the hydroelectric power engineering installation construction and operation zones; data banks for the status of engineering installations and natural environment for the ASUTP of complex hydraulic systems; and information advisory systems for planning the operating conditions of large water works projects.

**Electric Power Industry.** More than 80% of all electric power plants in Russia are united into the Consolidated Electric Power System (YeES). The total capacity of the power plants is about 200 GW. The most powerful power plant is the Sayany-Shushenskoye (6.4 GW). The highest electric power transmission line voltage is 1,200 kV.

Integration of most of the power plants into a single network of transmission lines makes it possible to considerably increase the reliability of electric power supply to the energy users as well as considerably decrease the reserve capacity of the power plants (to 15-17 GW).

Increasing the electric power plant capacity is an efficient means of lowering the cost of electric power generation. Yet it runs into considerable obstacles of an environmental origin: flooding large territories and taking them out of economic circulation in developing large GES; excessive atmospheric and soil contamination due to the development of large TES; an excessive increase in the water temperature in the water basins used for cooling waste steam in the development of thermal and nuclear power plants.

These environmental problems necessitate the development of research aimed at increasing the electric power plant efficiency so as to increase the power of the generating units without increasing the harm they inflict on nature.

Increasing the NPP operating reliability is an important direction in power engineering research.

In addition to the purely structural improvements in nuclear reactors, it is necessary to develop an automatic reactor control system which would fully eliminate response to erroneous operating personnel actions. In the case of a severe violation of the operating rules leading to an impermissible change in the regime parameters, it is necessary to ensure that the reactor is automatically withdrawn from the operating condition regardless of the subsequent actions either by the staff or by outside persons (in the case of sabotage). Only such an approach can fully eliminate the possibility of an accidental development of events at an NPP which will lead to unpredictable consequences on a catastrophic scale.



Increasing the technical and economic indicators of aerial electric power transmission lines is a rather important research trend in the field of increasing the reliability, economic efficiency, and ecological safety of Russia's electric power systems; the following indicators are considered: the line capacity or the maximum power transmitted over the line; the cost of electric power transmission; and the ratio of the line capacity to the width of its right-of-way.

The transmission line capacity is being increased by increasing the operating electric power transmission voltage. Today, the highest operating transmission voltage attained in our country is 1200 kV. It ensures economical transmission of electric energy to a distance of up to 2000-2500 km with an efficiency of at least 0.85-0.90. Yet the extent of Russia's territory on which the Consolidated Electric Power System was developed is much larger (5,000-6,000 km). Organization of power flows to a distance of over 3,000 km is expedient in such an extended power system. In so doing, hydroelectric power plants in Siberia can be efficiently utilized to cover peak loads in the Urals and in the European part of the country while an efficient utilization of the time shift in peak loads in various time zones can be ensured. Both of these phenomena make it possible to considerably decrease the number and total power of electric power plants as well as realize considerable savings reaching billions of rubles. Thus, ensuring an intersystem power flow of 20 GW to a distance of 4,000-5,000 km makes it possible to reduce construction of power plants with a total capacity of 40 GW whose cost reaches at least 16 billion rubles. Yet the cost of electric power transmission is about 2 billion rubles, i.e., is lower by eightfold.

Yet in order to ensure efficient transfer of electric power to a distance of 4,000-5,000 km with an efficiency of at least 0.85-0.90, it is necessary to develop electric power transmission lines with a working voltage of at least 1,800 kV.

With respect to the foregoing, mastering the next stage in the transmission line voltage (1,800-2,000 kV) poses not only purely engineering but also an important economic and political task.

Development of powerful electric transmission lines instead of a large number of electric power plants also alleviates the solution to ecological problems. The territory occupied by power plants, including hydroelectric pumped storage, decreases considerably. At the same time, power line rights-of-way can be effectively used for productive tree plantations with a plant height of no more than 5-6 m, fruit orchards, nut trees, various types of cedar wood, etc.

New possibilities of increasing the capacity of aerial transmission lines have been identified in the past decade due to optimizing the conductor arrangement in space. It was established that at a given working voltage, the aerial transmission line capacity can be increased indefinitely. The problems of design execution of the

new type of lines (compact) have been solved since in addition to an increased capacity, these lines have a considerably smaller transverse dimension. Likewise, the development of such lines will make it possible to save considerable areas. Allowing for the fact that about 1 million hectares of forest has been cut for power line rights-of-way, a considerable decrease in the transmission line right-of-way width will make it possible to preserve considerable forest areas.

Mastering new types of transmission lines calls for developing new forms of high-voltage equipment, primarily controllable users of the excess reactive aerial transmission line power—controllable shunt reactors. Moreover, it is expedient to develop a universal type of device which also makes it possible to limit the switching of voltages simultaneously. Such research and developments may be performed using physical and mathematical models on computers.

In solving these problems, one must take into account the outlook for realizing the developments not only in the domestic but also the international marketplace.

The development of consolidated power systems and especially the YeES considerably changed the high-voltage network structure and led to the appearance of intersystem super high voltage transmission lines while the network configuration became much more complicated. These factors pose new problems to the developers of emergency prevention automation device facilities and relay protection. The problem of developing relay protection with the shortest possible operate time (under 20 ms) during which it must not only establish the fact that there is a fault in the line but also locate this fault has been formulated.

The development of equipment with the utmost utilization of structural materials leads to their high load even under normal conditions. In addition, in a number of cases the sharp boundary between normal and emergency conditions becomes blurred. Nevertheless, relay protection must discriminate between these conditions due to its high sensitivity.

Today, relay protection devices are being switched to a new component base. Old protection devices on the basis of electromechanical relays are being used at existing electric power plants and substations. Yet the new designs of relay protection devices and automatic devices are being produced only with analog and digital computer technology elements. Consequently, many new problems arise. The problem of the relay protection structure must be solved before all others. It is possible to develop versions of protection facilities consisting of individual relays executed with a new component base and utilizing a single complex in the form of a dedicated computer.

Both individual relays and integrated devices of generator, transformer, and transmission line relay protection have been developed using new elements. With respect to their sensitivity, selectivity, and response speed, the

characteristics of these devices have been improved compared to the electromechanical relay-based protection systems. Now it is possible to develop new relay protection operation algorithms which have not been realized thus far with electromechanical relays. The new algorithms create additional possibilities for improving the protection device characteristics.

The advantage of the new component base is not only in improving the engineering characteristics. The production technologies of protection devices are also changing—they are being assembled from ready mass-produced radio electronic industry elements. This accelerates the assembly of the protection devices and leads to a decrease in the current consumption from the instrument current and voltage transformers and a decrease in the overall dimensions and mass of these devices.

The number of protection device sets at electric stations and substations is increasing very fast which leads to considerable difficulties in servicing and checking them. In this respect, protection devices using operational amplifier and microprocessors are rather promising. In addition to the principal operating algorithm, a built-in testing and diagnostic module can also be incorporated into the design of such devices which is very important in their operation.

It is suggested that data on the status of the relay protection devices and automation devices be displayed on a computer screen at large stations and substations. This will make it possible to monitor the set points, perform check tests, and accumulate statistical data on the operation of the protection devices.

The use of microprocessors is promising from the viewpoint of standardizing the relay protection devices. The same microprocessor type can be used for developing any relay or an entire protection complex. Only the programs embedded in the operation of the protection devices must be different.

Development of Automatic Control and Regulation Facilities for Ensuring the Stability of Powerful Power Pools. Stable conditions of YeES with an installed electric power plant capacity of about 300,000 MW was attained by developing a broad range of hierarchical automatic control and regulation systems as well as constructing transmission lines with the highest voltage classes of up to 750 and 1,150 kV.

The development of modern aggregate and station level controllers became an important step toward developing automatic control systems. These include individual and group generator and turbine controller which not only maintain the local regime parameters at a given level but also ensure follow-up action in response to system-level signals. Their implementation facilitated a considerable increase in the power system stability with long transmission lines and weak intersystem links.

Studies of parallel operation of power systems show that the limiting values of intersystem power transfers are determined by the motion components with a frequency of about 1 rad/s; these can be damped by using system regulators of the generator excitation controllers at large principal power plants. In this case, positive effect is attained only with a coordinated selection of the topping cycles of system regulators.

For energy pools, ensuring such coordinated operation of controllers at many power plants and a number of substations with powerful reactive power sources will create considerable difficulties under operating conditions.

Consequently, it is proposed that the power flow stabilization in the electric power transmission line close to stabilization achieved in using the direct current rectifying-inverter inserts be ensured by means of automatically controlling the generator excitation or the reactive power sources.

The search for ways of ensuring the static stability is an important factor which determines the performance of extended power pools. The solution to this problem is quite important for efficient operation of adaptive centralized emergency prevention control systems (ATsSPU) whose role in power pools is continuing to increase.

Subsequent development and performance of YeES in the near future will proceed under difficult conditions caused by the desire to transfer the highest possible power over relatively weak intersystem power transmission links which, combined with the extraordinarily large extent of Russia's YeES, will call for solving a number of scientific and technical problems which may include the following.

1. Developing a system of automatic regulation of YeES conditions intended for ensuring the static stability and damping fluctuations in powerful extended energy pools with considerable transit power flows, including the following components: the selection of a general design, a complex of facilities and the laws of their control; the development of software for analyzing the performance of control facilities at the local and system-wide levels.
2. Developing methods for determining the scope, positioning, and control laws of reactive power sources and users necessary for realizing the intersystem and the changes which correspond to the link capacities while minimizing the constraints on stability in the deterministic formulation and allowing for random operational perturbations.
3. Assessing the utilization efficiency of transmission lines with an elevated natural power with controlled reactors and other facilities ensuring the stability and damping fluctuations in power pools with a complex structure.

4. Developing software for solving a broad range of problems of the dynamics of powerful power pools aimed at utilizing multiprocessor computers with a high output which ensure multiparametric optimization both in the interactive mode and by a fully formalized numerical search.

### Altay Officials Resurrect Plans for Controversial Katunskaya GES

93WN0110A Moscow TRUD in Russian 4 Nov 92 p 2

[Article by Yuriy Tokarenko: "The Death Project: Advocates for the Construction of the Katunskaya GES Attempt To Make It a Reality in the Altay"]

[Text] Novosibirsk—It was an alluring idea—to build a hydroelectric power plant on the Katun River. "Imagine,"—the idea's initiators tried to convince people,— "there will be so much energy, that..."

They were concerned for their native Gornyi Altay, which does not have enough electricity. And while they were busy being concerned, the project appeared. But here's the problem: based on a series of studies, the Russian Federation Supreme Soviet commission on ecology announced its verdict: the project is insolvent, its financing will be withdrawn, and a liquidation commission will be created.

However, times change, and with them changed the status of the Gorno-Altay Autonomous Oblast, which allows it to make laws independently. Sovereignty inspired the project's ideologists and advocates to new efforts—its chief engineer and construction director, A. Pigalev, and Altay Republic Supreme Soviet chairman, V. Chaptynov. They began to "nudge" their baby along again: the GES [hydroelectric power station] must be built!

This was followed by the first protest from neighboring oblasts belonging to the "Siberian Accord" association. At the insistence of Novosibirsk Oblast leaders, an expert commission was created, receiving at its disposal the conclusions of independent scientists, and analyses made by many organizations.

I became acquainted with them thanks to the chairperson of the Committee to Save the Rivers of the Ob-Irtysh Basin, G. Kuchina. Galina Nikolayevna has compiled a dossier of many volumes on the problems of the Katunskaya GES.

—First of all,—says G. Kuchina,—this GES will not solve the Altay's energy problem, where every year up to five million kilowatt hours are wasted. Besides this, it does not take into consideration the seismic activity of this region, which has already experienced an earthquake with a force of 10-12 points,—after all, the dam is designed for only seven points. The Institute of Mathematics at the Siberian Division of the Russian Academy of Sciences has calculated that in the event

that it breaks, a gigantic, 20-meter wave will reach Novosibirsk in literally hours, destroying everything in its path.

But this is not all. The Katunskaya GES will doom the rivers' flood plains to eutrophication, which will be followed by famine and the destruction of the environment. The Novosibirsk GES will find itself without water.

It is true that lately the project's developers have been talking in the newspapers about certain changes in its parameters. Allegedly, the dam's height of 180 meters has been decreased to 50 meters, the size of the reservoir has been reduced. However, there are no changes at all in the working project documents received from Gorno-Altay. What is pushing them to be this cunning? Could it be the fact that out of the 59 million rubles already spent on the realization of this project, the construction directors have only been able to account for 19, putting nearly 40 million under the heading of "miscellaneous"? Now, like it or not, nobody will be the wiser...

This information is already worrisome enough. We cannot help but recall other facts.

Back in April, 1990, a public scientific conference in Novosibirsk expressed the unified position of experts in various fields: realization of the Katunskaya GES project will be an impetus towards global ecological catastrophe.

And how does the project threaten Siberians, whose health is, even without it, worse than average for Russia? I took this question to a person whose name is pronounced with respect by medics and environmentalists all over the world, the initiator of the "Living Earth" concept of human survival. An active member of the Russian Academy of Medical Sciences and the Russian Federation Academy of Natural Sciences, director of the Institute of Human General Pathology and Ecology at the Siberian Division of the Russian Academy of Medical Sciences, V. Kaznacheyev reminded me of a forgotten fact:

—The idea for the Katunskaya site goes back to 1937. A country where millions of lives were burned in a human oven, understandably, would not have begrudged itself new victims, colonizing Siberia for the sake of the raw material, manufacturing and industrial, military base. And now the renovated project, a child of the totalitarian regime, the birth brother of the Belomorkanal and Magnitka, built on bones, has come into its own. The proposed changes are only cosmetic, and do not decrease the potential harm...—Katun Canyon is a natural paleo-center for a geochemical anomaly,—Vlail Petrovich demonstrated on a map. Here, on the Earth's surface, polymetallic ore combinations show up that contain a large assortment of elements capable of having an unfavorable effect on humans. These are mercury, arsenic, antimony, cadmium and so on. Any kind of powerful technogenic interference, like the construction of the



GES, carries with it the possibility of extremely dangerous consequences for this region of Gornyi Altay. It will lead to an increase in the general concentration of microelements and their combinations that are harmful to our health. They will simply leak out, uncontrollably. A risk of ecological catastrophe will arise on the scale of the entire Ob River Basin and its shelf in the Ledovityi Sea.

Even today, according to medics, like a science fiction disaster movie, we can roll out the details of the effects. A rise in moisture in the air will lead to a change in climate and an increased risk of mercury and other toxic combinations getting into the lungs. A change in the biospheric structure will cause a rise in the number of encephalitic ticks—the scourge of Siberia, for which no antidote has yet been found, that will lead to an explosion of infectious and animal-carried diseases. One more detail—if the Russian rivers up to the Urals can cleanse themselves in 20 kilometers, then in West Siberia, which will have to deal with the effects of the project, it takes 200 kilometers. Even now, states V. Surzhikov, Institute of Complex Problems of Hygiene and Occupational Illnesses at the Siberian Division of the Russian Academy of Medical Sciences deputy director, the Siberian rivers have become arteries for all kinds of infections and chronic illnesses.

V. Kolyado, head of the Altay Kray Laboratory for Problems Concerning Health Maintenance in the Population, citing studies made by specialists in Barnaul, quotes significant figures: the mortality rate in the kray from malignant formations has risen by seven times.

According to a medical and biological study done on the GES project, heavy metals are already present to one or another extent in the bodies of 30 percent of the residents of the Katun's banks who participated in the study. In one third of those tested, a high percent of carriers of defective genes was discovered. Signs of disease in internal organs point to mercury poisoning microsystems. These heavy metal combinations have been found in the needles of trees, and in lichens and edible plants. The greatest number of illnesses of the digestive tract, kidneys, cardiovascular and nervous systems are actually noted in the region of the future range of the hydroelectric power plant, where the total amount of mercury in the water and in basic human biological fluids is especially high. What will happen when the water rises, and begins to wash the mercury and arsenic directly down from the cliffs surrounding the river?

The joy Russians experienced with the end of the voluntaristic epoch of the redirection of the northern rivers and other senseless projects has, unfortunately, turned out to be premature. The transfer of power to local authorities has become far from a guarantee that human rights will be observed or that natural riches will be preserved for our children and grandchildren.

Representatives of the medical and biological sciences are convinced that the realization of projects like Katun

can be put under the category of international ecological arbitrariness. The situation, they believe, requires a legal evaluation. And on an international level.

#### **New Water Resistant Industrial Explosives Based on Ballistic Solid Fuels and Powders**

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No 6, Jun 92 [Signed to press 01 Jun 92] pp 37-39

[Article by V. V. Galkin, B. M. Baloyan, V. V. Falko;  
UDC 622.235.213.3]

[Text] Recently, the consumption of industrial explosives has risen considerably in the mining industries and in construction. In particular, this applies to water resistant explosives since active open pit mines are becoming deeper and deeper. This results in an increase in the number of water filled holes which are blasted and the specific consumption of explosives.

At the same time, the amount of industrial explosives produced has practically remained unchanged due to limited industrial capacity. Another reason is the slow rate of constructing and starting up locations for manufacturing the simplest explosives and slurry explosives right next to the locations where the explosives will be used. As a result of all this, there is a marked shortage in explosives, especially water resistant ones.

One of the ways to reduce the shortage of water resistant explosives is to carry out blasting using the large amounts of items which are made out of ballistic fuel or artillery ballistic and pyroxilin powders, and which have now been removed from the arsenals.

Calculations carried out by the express method (1) show that the energy characteristics and detonation parameters of powders and ballistic fuels at a density of 0.9-1.0 grams per cubic meter are at the level of a granulatole.

Despite some early, positive results which were achieved when granulated pyroxilin powders were used during blasting as blast-hole, deep-hole and pressure charges (2-5), and when items with different brands of ballistic solid fuels were used as trench crater charges, it must be recognized that these operations were small in size and purely experimental in nature. Moreover, the issue of safety during the storage, transportation, and preparation of explosives for charging and blasting operations was not examined.

The most widespread method for carrying out blasting in mining and construction is the deep-hole charge method. However, the high sensitivity to mechanical impacts, susceptibility to electrical discharges when being poured (pyroxilin granulated powders), extreme difficulty in initiation (artillery powders and certain brands of ballistic fuels), as well as the form and size of the finished items, the type of packing materials and weight of the item in one container make these explosives ill-suited for use as deep-hole charges when large explosions are being carried out. Therefore, the main goal when using items



made out of powders and ballistic fuels under the given conditions is ensuring the items have a set of technical and operational properties which ensure a level of safety which is not inferior to those industrial explosives used to carry out large explosions.

As a result of joint research carried out in the Institute of Chemical Physics of the Russian Academy of Sciences and the "Soyuz" L [expansion not given] scientific production association, water resistant prilled explosives based on items made out of ballistic fuels and powders were developed. They are BP brand granipores, whose chemical and physical properties are listed below.

Indicators	BP Brand Granipores	Granulotole (6)
Calculated		
Explosion energy, kcal/kg	830-850	870
Volume of gases, l/kg	870-890	750
Oxygen balance, %	-45-50	-74
Volume of poisonous gases in terms of CO, l/kg	260-280	320-330
Experimental		
Bulk density, g/cm <sup>3</sup>	0.8-0.9	0.9-1.0
Critical charge detonation diameter,* mm:		
Under dry conditions	100-120/ 150-160	80-100
Under wet conditions	80-100/130- 140	
Detonation velocity, km/s:		
Under dry conditions	4.8-5.2	4.0-4.6
Under wet conditions	6.1-6.3	(5.5-6.0)**
Sensitivity to shock:		
Explosion frequency, %	20-24	8-12
Sensitivity to friction on the K-44-Sh device, kgs/cm <sup>2</sup>	2180	3000
Flash point, °C	160-180	290

\*The numerator contains values  $d_{cri}$  for a mixture with pyroxilin powder 4/7 in a cardboard shell and the denominator—with pyroxilin powder 12/7 in a steel one.

\*\*The detonation velocity values were obtained in a 40 millimeter diameter steel tube.

The tubes of artillery powder were ground on a machine developed by the "Soyuz" L scientific production association. Standard powder production technology was used to obtain the granules of ballistic fuel, since a machine for grinding items made of ballistic fuels is still in the development stage. The data given above show that for all the indicators the BP granipores are not inferior to the granulotole.

The BP granipores do not contain water soluble components. The amount of time the granipore charges and the granulotole charges remain in water filled holes is determined by the water resistance of the detonator blasting caps and the detonating cord used to initiate the blast.

Granipores are more resistant to alkali and acidic mediums than granulotoles are. This means the former are very promising for use in open pit mines, when mining for chemical raw materials and breaking sulfide ores. The presence of a special additive in granipores eliminates the generation of dust and electrical discharges, as well as setting or stiffening at temperatures lower than minus 50 degrees centigrade.

Industrial testing of granipores was conducted in an open pit mine of a mineral resources integrated factory and the open pit mine of the Teplogor gravel factory. Drilling and blasting operations at these open pit mines are carried out by Construction Administration Number 74 of the "Transvzryvrom" Trust.

The rocks that were broken off in the first open pit mine were represented by granites of the ninth group and in the second open pit mine by gabbro-diabases of the eleventh group, according to Building Standards and Rules. The Protodyakonov hardness coefficient for the indicated rocks is 11-14 and 9-20. According to the MVK [expansion not given] classification, the category for fracturing is II and III, respectively. The diameters of the boreholes are 216 mm and 269 mm. The depth of the boreholes is 18-20 m. The height of the water column in the hole is from 3.5 to 14 m.

Trial lots of prefabricated granipores have been supplied for testing in standard paper bags with polyethylene bag insert. The holes were manually charged with the granipores. The deep-hole charges of granipores were initiated by two boosters. One was located in the lower part of the charge, the other in the upper part.

Doubled T-400G TNT blocks and a DShE-12 brand detonating cord were used as the booster. Short-delay firing with KZDSh-69 pyrotechnic relays was used.

#### The Main Parameters and Results of Two Trial Explosions

Explosive	BP-3 Granipore	Grammonite 30/70	PB-1 Granipore
Bench height, m	Granite 16	Granite 16	Gabbro-diabase 13-16
Hole depth, m	18	18	17-20
Hole diameter, mm	216	216	269
Water column height, m	3-8	3-8	up to 5
Line of resistance along the bottom of the first row, m	7	7	7-8
Number of rows	5	5	5
Row spacing, m	5	5	5.5
Hole spacing, m	5	5	5.5
Number of exploded holes	57	63	22
Weight of charge in hole, kg	390	510	550-580
Height of charge in hole, m	14	16	12-13

**The Main Parameters and Results of Two Trial Explosions**

Consumption of explosives per explosion, kg	22230	30000	13380
Length of drilled holes, m	1026	1134	440
Blasting pattern	Wedge-shaped cut hole		By rows
Volume of exploded rock, m <sup>3</sup>	26800	32000	143000
Rock yield from 1 meter of hole, m <sup>3</sup>	26.1	28	32.5
Specific consumption of explosives, kg/m <sup>3</sup>	0.82	0.93	0.93*
Oversize rock content, %	3-4	5-6	5-7
Depletion of bench to the bottom	Good	Good	Good

Note. The specific consumption of grammonite 30/70 under the same conditions is 1.06 kg/m<sup>3</sup>.

The data which are presented show that the main indicators of the explosion (specific consumption, oversize rock yield) are improved when granipores and not grammonite 30/70 are used.

More than 50 tons of granipores were used throughout the period the industrial tests were conducted. Based on the test results, Gospromatomnadzor has released BP granipore for regular use.

Up to the present time, approximately 1,000 tons of granipores have already been used for blasting. Further, there are no recorded instances of misfiring or partial explosions. In partially water filled holes, it was economically advantageous to use BP granipores in combined charges (the dry portion of the hole is charged with non-water resistant explosives.)

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#### Electromagnetic Hammers for the Construction of Offshore Development Projects

937F0030B Moscow GORNYI ZHURNAL in Russian No 7, 92 [Signed to press 18 Jun 92] pp 36-38

[Article by N. P. Ryashentsev, B. F. Simonov, A. I. Kadyshchev, Yu. P. Kravchenko, N. A. Britkov, F. M. Uryupin; UDC 622.242.002.289]

[Text] In recent decades, the rate at which offshore deposits of mineral resources have been developed has sharply increased. This especially pertains to oil and gas, the mining of which on the sea shelf constituted 20 percent and 10 percent, respectively, in the 1980s and 28 percent and 25 percent in the 1990s. It is predicted that by 2020, mining of these deposits will reach 65 percent of the total volume of world mining of hydrocarbons (1, 2).

In addition to oil and gas, solid mineral resources have been exploited for some time. Moreover, this exploitation is continually growing. This pertains to coal (England, Japan); iron ore (France, Japan); platinum (USA); cassiterite (Indonesia) and so on. One hundred percent of the zirconium and rutile, 80 percent of the ilmenite and 40 percent of the cassiterite supplied to the foreign world market are mined by the sea method.

The deposits listed above are exploited by various means by using fixed offshore platforms and piers. When they are constructed, the most basic problem is affixing them with piles driven into the sea floor by hammers. At the present time, the world standard is to use steam-air or hydraulic hammers with an impact force of 80-2000 kJ. However, they have a number of disadvantages, the main ones among them being hampered, difficult operations at low temperatures and contamination of water areas by oil when steam-water hammers are used or when feeder hoses of the hydraulic hammers rupture. A very pressing task is to create environmentally safe hammers for driving the piles when offshore development projects are built.

One of the most promising trends for developing offshore hammers is creating electromagnetic hammers (3). This research is conducted in the Institute of Mining and the Russian Academy of Sciences Siberian Division Special Design Bureau of Applied Geophysics. Electromagnetic hammers are highly reliable at channeling electric energy along a cable as compared to a steam line or hydraulic hose. The absence of oil makes them absolutely environmentally safe. They may be powered from the energy system of the floating crane, which provides for very convenient operations. The hammers operate steadily at low temperatures, which means the pile driving process may be automated.

There are double- (fig. 1) and single-acting (fig. 2) electromagnetic hammers. At the present time the MEM-30 and MEM-100 electromagnetic hammers with an impact force of 30 kJ and 100 kJ have been created. The MEM-400 hammer is now being developed. It has an impact force of 400 kJ. The technical characteristics of the hammers are given below. Industrial testing of the MEM-30 hammers was conducted in the "Chernomorneftegas" production association by attaching offshore fixed platform housing units above a gas deposit on the Black Sea. The results are available (5).

The MEM-30 hammer (fig. 3) was powered by an independent, 200 kilowatt DES-20 electric power station. The hammer was installed with an electric diesel crane mounted on a platform. Its lifting capacity is 16 tons.

Technical Characteristics of the Hammers

	MEM-30	MEM-100	MEM-400
Impact force, kJ	30	102	400
Impact frequency per minute	54	24	24
Diameter of piles to be sunk, mm	426, 478	426-812	720-1200
Voltage of the tri-phase power supply network at 50 Hz, V	380	380	660
Average Power Consumption, kW	75	115	600
Power Consumption Peak Value, kW	127	250	750
Dimensions of the Hammer:			
Length, m	4.5	7	11
Largest diameter, m	0.6	1.2	1.6
Block Head Weight, kg	2000	6000	25000
Overall hammer weight, t	6.5	18.6	70

During testing, the piles were driven. They were 478 mm in diameter, 60 meters long and they were driven to a maximum depth of 15 meters. The piles were driven in at a 15 degree angle. All four piles were driven to the planned depth of 15 meters. An analysis of the data shows that even within the boundary of the one platform, identical piles are submerged differently.

The differing rates at which submersion occurs determine the various amounts of time it takes to drive the piles (from 25 minutes to 53 minutes) in order to reach the planned depth of 15 meters. The reason why the piles within the boundary of one platform take varying amounts of time to submerge is due to the fact that limestone beds are encountered, and the tubular piles which are submerged have different curvatures, which cause the varied resistance force to pile movement in the leg of the platform as well as in the leader guide. For the hammers which were examined, it takes about 1.5-3.5 hours to submerge each pile, not counting the time to solder the joints when the piles are built up. If the time it

takes to build up the piles is counted, it takes 6-8 hours to drive one pile with a diameter of 478 mm and a length of 60 meters.

As the calculations showed, the MEM-30 electromagnetic hammer can drive steel tubular piles with diameters of 426 and 478 mm to a maximum depth of 15 meters in the soil of the Black Sea basin.

In order to drive these same piles to a greater depth, or drive larger diameter piles, the hammer impact force must be increased. In order to do this, the MEM-100 electromagnetic hammer was created.

Industrial testing of the MEM-100 hammer was conducted in the "Chernomorneftegas" production association when tubular metal piles were submerged into the sea floor, when a moorage was built and when water isolating jackets were being hammered in order to conduct offshore drilling. The hammer was also used to submerge piping when shoreline construction was being carried out.

The tests showed that the MEM-100 hammer can submerge piles or water insulating jackets with a diameter from 426-812 mm to a depth of 30-35 meters and 20-25 meters, respectively. While the testing was being conducted, the MEM-100 electromagnetic hammer showed

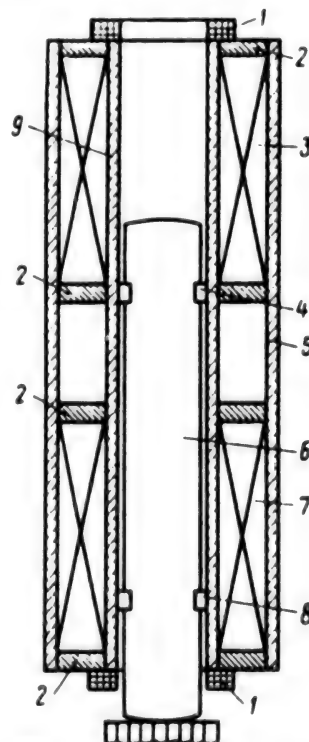
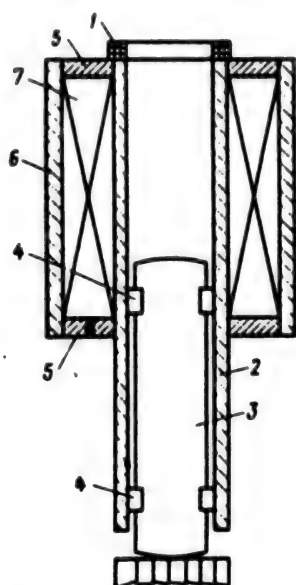


Fig. 1. Dual-Acting Hammer

1. Variable-induction position pickup; 2. Terminal; 3. Back stroke winding; 4. Slip bushing; 5. Housing; 6. Head; 7. Forward stroke winding; 8. Slip bushing; 9. Guide.



**Fig. 2. Single-Acting Hammer**

1. Variable-induction position pickup; 2. Guide; 3. Head; 4. Slip bushing; 5. Terminal; 6. Housing; 7. Winding.

a high degree of productivity, was absolutely environmentally safe, operated reliably, displayed high energy characteristics (efficiency up to 35%), and was easy to operate. The hammer can be powered from an independent electric power station of at least 250 kW or from the on-board line of the floating crane. It is advisable to equip low lifting capacity floating cranes (up to 150 tons) with this hammer in order to drive piles during offshore development projects (construction of wharves, piers and fixed offshore platforms at a sea depth of up to 45 m). This hammer can also be used for construction on the mainland when reinforced concrete piles or rows of sheet piles are being driven.

Based on the range of operational indicators, and especially from the point of view of environmental safety, the electromagnetic hammers have an advantage over the steam-water and hydraulic hammers used today. This makes it advisable to develop a parametric range of electromagnetic hammers to carry out offshore development projects.



**Fig. 3. The MEM-30 Hammer During Industrial Testing When a Pile on the Housing Unit of the Golitsina-4 Platform Was Driven**

The testing conducted with the MEM-30 and MEM-100 hammers showed that the MEM-100 hammer with a impact force of 100 kJ should be first in the parametric series of electromagnetic hammers for offshore development projects.

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### Using Aerospace Data in Downplanning Design

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STROITELSTVO in Russian No 2, Feb 92 pp 20-21

[Article by I.L. Titova, Russia's Ministry of Architecture, Construction, Housing, and Public Services; UDC 528.7:711.011]

[Text] At today's stage which is characterized by rapid changes in all aspects of the life of our society, the need for urgent and professional solutions to the problems of efficient territorial organization of the society, efficient use of natural resources, protection of the environment, and a large number of social, economic, and other issues is becoming increasingly urgent. These problems can be solved by urban development facilities through a deliberate organization of a system of scientifically sound territorial designs and implementation of proposed designs. Moreover, the requirement to shorten the design duration and the quality and information saturation of the design and planning documentation is becoming especially urgent.

Data from remote sensing of the earth from space which reflect the multifaceted characteristic of the state of the portion of the earth surface under study and its uniqueness meet the conditions, making it possible to carry out a comprehensive estimate of the territory and predict with greater certainty the changes in the urbanization processes, population distribution, and the planning and environmental situation as well as a few possible design versions. Consequently, the use of remote sensing data in the design process along with using economic-mathematical methods and automating design may ensure a qualitatively new level of town planning documentation and make it competitive.

Aerospace remote sensing data are widely used in the national economy. There are industries which for many decades have conducted scientific research in this field and have achieved considerable success. Departmental systems have been created for tracking the dynamics of the natural environment processes and manmade activity by the factors which are of interest to these industries. For example, the Land Reclamation Service has been observing changes in the water environment with a certain regularity and the state of the irrigation network, floods, the moistening degree in the territory, etc. The service of the State Committee on Hydrometeorology records the state of the air basin and its contamination. The Geology Ministry (the Aerogeologiya Production Geological Association) is monitoring the changes in the earth crust and unfavorable geological processes, searches for mineral deposits, etc. In forestry, monitoring elements and study of the quantitative and qualitative state of the forests are sufficiently well developed. The Agrosursy Company has been involved in collecting and processing aerospace data and monitoring the process dynamics in every culture. The Priroda State Center has for many years investigated the natural resources comprehensively (the KIPR programs), etc.

In recent years, new companies have sprung up, including those prompted by the conversion of the space facilities which possess advanced technical facilities and are successfully helping to solve national economic problems.

Since 1984, the RSFSR State Construction Administration has been carrying out research into the possibility of using remote sensing data in town planning design on Russia's territory. It was sponsored by the Regional Planning Directorate, the Leningrad Civil Engineering Institute, the State Town Planning Institute, and the Leningrad State Town Planning Institute.

Space remote sensing data were used in such efforts as designs of regional zoning in Kalmykiya and Buryatiya, territorial designs of environmental protection in the Baykal-Amur main line regions, the Urengoy-Pamary-Uzhgorod right-of-way, and the Baykal Lake. This experience was examined and approved by the Scientific Technical Council of the Committee. The decision was made to draw a comprehensive program of scientific research work on using aerospace remote sensing data in the design and planning documents. It was expected that the Leningrad Scientific Research Institute of Urban Development, the Moscow State University, the Priroda State Center, and the Urban Development Institute at the Academy of Sciences with their scientific and technical potential would be involved in carrying out this program.

Yet the difficulty of obtaining information about foreign practices and the excessive scarcity of the resources allocated to Russia's State Construction Administration at that time for scientific research and logistical support did not make it possible to carry out scientific work in the framework of the program, as a result of which the effort was reduced to sporadically using remote sensing materials in specific projects, whereas the need to examine the specific features of interpreting aerospace imagery for a range of urban development tasks at various taxonomy levels remained urgent and no experience of information collection by other departmental services performed for the purposes of narrow branches could be used. It was necessary for it to develop its own experience and own techniques.

Today, considerable opportunities arise for using foreign experience and technologies, acquiring modern facilities, involving foreign companies in solving specific town planning tasks, and considerably expanding scientific research work in this field. And the use of new equipment and technology made it possible, in principle, to produce new designs and methodological solutions for using aerospace data in designing. Allowing for the use of modern computer-aided information systems and computerized facilities for collecting, storing, and processing data, it is now possible to organize continuous town planning designing and a system of monitoring the dynamics of urbanization processes, the planning and

environmental situation, and to monitor the implementation of the designs and plans. The corrected comprehensive target program for using and implementing aerospace information in town planning design, allowing for the new conditions, consists of four parts:

experimental pilot efforts at various levels (population distribution patterns, territorial comprehensive environmental protection plans (TerKSOP), regional zoning diagrams and projects, town master plans, etc.);

a complex of scientific research work (divided into taxonomy levels which correspond to the stages of town planning designing);

education and training of staff (it is suggested that the training course be organized on a contractual basis involving Moscow State University); and

logistical support.

Experience shows that the methodological approaches for using the remote sensing information can be successfully used in close association with the experts capable of simultaneously working with aerospace imagery and possessing sufficient experience in practical town planning designing. Consequently, special staff training is urgently needed. In addition to developing methodological premises, the program should be aimed at ensuring such work determining the town planning policy as the "Master Plan of Population Patterns in the RSFSR Territory to the Year 2015", "Town Planning Concept of the Volga River Basin", a number of territorial comprehensive environmental protection plans and regional oblast zoning layouts, etc.

#### **Town Planning Design Experience Regarding Chernobyl Catastrophe Cleanup**

937F0026B Moscow PROMYSHLENNOYE  
STROITELSTVO in Russian No 2, Feb 92 pp 23-24

[Article by V.V. Klimov, Chief Architect of the Belarusian Scientific Research Institute of Town Planning Design; UDC 711.011:69.059.22]

[Text] Decision-making on comprehensive territorial management is preceded by a process of studying the evolving situation, identifying the territorial and spacial problems (environmental, social, and economic), and determining their urgency. Thus, the radioactive contamination of the terrain due to the Chernobyl catastrophe noticeably increases the urgency of ecological problems in a number of Belarus, Russia, and Ukraine oblasts and in some of them, some of the territories are on the brink of environmental disaster. A comprehensive environmental assessment of the territory as well as the related evaluation of the maximum possible demographic capacity of the territory must become the principal subject of the studies of the evolving situation in areas of radioactive contamination. A retrospective estimate of the available planning structure and functional

utilization of the territory will be secondary in importance. The environmental situation assessment criteria must correspond to national and republican legislations and industry-wide regulatory documents. An assessment of the planning structure and functional territory utilization must reveal the implementation degree of the preceding regional planning decision and the reasons for existing deviations.

The development experience of the early designs of comprehensive territorial management (SKTO) of the oblasts affected by radioactive contamination attests to the fact that the level of informativeness and detail which is traditional for regional zoning plans is clearly insufficient. A noticeable increase in the source data volume is attributed to the need to take into account the new factors, primarily from the group of environmental problems (mostly related to cleaning up the radioactive contamination of the territory) as well as from the group of economic problems (reorienting the economic complex from the command-administrative control methods to a system of market mechanisms and the development of enterprise, tolerance of a mixed economy in the agricultural sector of the economy, development of free economic zones, etc.).

The database increases significantly in developing the SKTO for the oblasts from whose territory the population is to be relocated. Here it is necessary to solve the problem of first-priority and subsequent relocation of residents on a comprehensive and balanced basis and redeploy the principal material and production funds of the affected regions since the principal condition ensuring successful execution of such migration is simultaneously providing all those being relocated with housing and jobs. The diversity of factors and conditions which form the initial database may be also complemented with a block of data on new techniques and trends which are not traditional for the oblast plans. Here, data on the results of applied sociological research which promptly increased the visibility of the decisions made on developing the inhabited localities allowing for the opinions of various strata of migrants can serve as an example.

During the work, it became necessary to make decisions on the basis of an expanded information content of value; as a result, a target model of the "Pereseleniye" computer-aided information system (AIS) was developed almost experimentally within the Bryansk oblast SKTO. This DPMS has a dual purpose: it can be used both in the course of design and planning work and in daily operation of various structures of the oblast administrative-territorial management, primarily at the Bryansk oblast executive committee which is the principal implementing agency of the SKTO.

Pursuant to the USSR law "on social protection of the citizens affected by the Chernobyl catastrophe" of 12 May 1991, the regime in the territory affected by radioactive contamination changes depending on the density

of the radionuclides spreading on the surface. The contaminated territory is divided into the following zones: alienation, migration, residents with a right to relocate, and residents with social and economic benefits.

The certainty of migration or the possibility of remaining in the zone is regulated not only by the contamination density but also by the average annual equivalent effective population irradiation dose. Yet to date, town planning design organizations had access only to the state hydrometeorological committee maps with radioactive contamination density zones. The maps showing the areas of the average annual effective population irradiation doses have not been provided to the institutes. Due to the lack of such data, we cannot but mention the report of an international expert group (Vienna, May 1991) one of whose conclusions stated the following: "It was impossible to confirm the initial soil contamination levels and population irradiation with iodine isotopes". Such a conclusion attests only to the fact that the average annual dosage rates for each person residing in unfavorable zones established just in 1991 cannot answer the principal question: what value of irradiation existed for the "iodine" factor in 1986 prior to shutting down the exploded reactor? It is possible that these circumstances are responsible for the absence of the areal maps identified by the effective population irradiation dose factor. Yet does it follow from this that in the design institution areals the radionuclide contamination density remains the sole criterion for estimating the vital activity regime on the radioactive contaminated territories.

Certain experience in solving the problems related to the Chernobyl nuclear power plant (ChAES) catastrophe has been accumulated at the Belarussian Scientific Research Institute of Town Planning Design. At the same time, it is obvious that the methodological principles of the SKTO development at an oblast level must be sufficiently versatile and adapted to any territory under design. The specific features of the SKTO content in each concrete oblast must be identified and executed in practice by the authors and developers directly in the course of the scientific feasibility and design studies.

We became convinced that at an oblast SKTO level, we can define the strategy of town planning and functional-planning territory development with a sufficient degree of feasibility while defining the regimes and parameters as well as priorities and limitations. It is recommended that project documentation of the territorial development of administrative regions be produced in the course of oblast plan implementation on this basis. Yet in developing the oblast system, it is necessary to utilize the premises from efforts on a broader territorial level (scope).

The principal section of the oblast SKTO is planning through which all branch and partial system developments are viewed. The principle of sufficient decentralizing of most types (functions) of public activity with an emphasis on the development of towns and rural areas

and peripheral regions impact zones of central towns, and the adjoining spaces must underlie the territorial plan development. In assessing the existing status, the systemic and problem approach are used as a methodological tool; in determining the development outlook, priority is given to the qualitative side of the vital activity environment formation.

The SKTO of an oblast (or another administrative-territorial unit) is regarded by the expert as one of advanced trends in the system of regional planning efforts. The methods, techniques, and procedures for carrying out situation research and adopting long-term strategic hypotheses of territorial development and the short-term town planning priority decisions based on them determine the SKTO obligations—primarily for territories with an extreme situation. The reasons for such situations may be natural disasters such as the earthquake in Armenia or manmade catastrophes such as the Chernobyl NPP accident.

Experience shows that compared to traditional execution of work on regional planning, the SKTO development time is shortened by an average of 1.5 times and in a number of cases, by twofold. The principal issue in the SKTO development is identifying the first-priority stage related to solving urgent tasks: moving the population from the affected areas, allocating emergency residential construction, territorial infrastructure installations, etc. Such a high priority stage carried out at an accelerated pace is approved by local administrative authorities and is implemented promptly.

The SKTO is a product of creative activity of scientific research organizations. Since the creativity process itself is permanent, the aforementioned approaches to developing the territorial management schemes and programs will change in time and improve. Consequently, a new trend in regional planning—the comprehensive territorial management systems—should not be constrained by any rigid methodological bounds.

#### Defense Potential and Its Utilization for Peaceful Purposes

937F0008A Moscow AVTOMATIZATSIYA I SOVREMENNYE TEKHOLOGII in Russian No 6, Jun 92 pp 30-35

[Article by L.K. Goncharova, L.A. Khantseva; UDC 654.061]

[Text] An "autumn show: 'mechanical engineering-conversion-market-91'" exhibit was held at the USSR exhibit of the achievements in national economy (known as the VVTs today) was held in Moscow between 19 November and 6 December 1991. Industrial enterprises, scientific research institutes, and design offices from the defense industry which participated in their exhibit offered their products, developments, and programs for use in the national economy for peaceful purposes.

We are offering to the readers a brief review of the exhibits presented at this fair which will undoubtedly interest you.

The PP-398M unit is intended for precious metal (Au and Ag) recovery from spent industrial solutions by the ion exchange liquid extraction method and makes it possible to obtain as a final product concentrated solutions of gold or silver salts suitable for reutilization in production. The concentrates produced by the unit are used to correct operating and prepare new gold- and silver-plating electrolytes. The precious metal recovery from the solutions is 100%

#### Technical Data on the Unit

Output, liter per hour	25
Install capacity, kW	3
Overall dimensions, mm	1200 x 1200 x 1700
Mass (kg)	470

The PV-25 centrifugal induction melting casting unit is intended for centrifugal casting of ferrous and nonferrous alloys into the investment casting molds. It makes it possible to produce perfectly precise and smooth castings from investment patterns of a complex configuration with pockets and threaded surfaces. Casting in a centrifugal force field ensures separation of the nonmetallic inclusions, an elevated casting metal density, an equivalent forged metal density, and the absence of hot cracks even when casting wrought alloys. The centrifugal force pressure makes it possible to fill the molds at a decreased metal temperature without the danger of "spilling" the complex elements.

#### Technical Data on the Melting Casting Unit

Maximum charging mass, kg	3.5
Casting mass, g	1-2,500
Smelting duration, no more than, min	3.5
Install capacity, kW	90
Maximum generator output, kW	50
Furnace, power supply frequency, Hz	8,000
Table rotation speed, min <sup>-1</sup>	20-250
Footprint, m <sup>2</sup>	16
Complete mass, kg	5,300

The PA-337 computer-aided production system (ATK) is intended for making parts from thermoplastic materials by injection molding using a waste-free technology. The complex consists of a slide for delivering the gating systems to the conveyor belt, another conveyor, a crusher, a screw-type mixing bunker, and a control unit. The PA-337 ATK interacts with the thermoplastic machine whose injection volume is 63-250 cm<sup>3</sup> with fittings with automatic pouring gate separation; the separated pouring gates travel down the slide to the belt conveyor and then to a rotary crusher; the crushed thermoplastic grid either travels to the secondary processing section for granulation or to a vacuum charger where it is loaded into the blending hopper; in the

blending hopper, primary and secondary raw materials are mixed in a certain proportion and are also mixed with the dye there.

#### Technical Data on the PA-337 System

Overall dimensions of processed pouring gates, mm	160 x 125 x 40
Installed capacity, kW	3.8
Planform overall dimensions, mm	3,000 x 5,000, x 1,600
Mass, kg	390

The industrial enterprises waste water treatment technology transfers organic and inorganic impurities which are harmful to the environment to a harmless form, or decreases their initial concentration to a level acceptable for discharge into sewers. The technology contains recommendations for removing surfactants, urea, phenols, formaldehydes, and fat- and petroleum-containing substances as well as the compounds used in movie and photographic material processing and recommendations for reutilization of concentrates. This technology is energy-saving and ensures production of environmentally clean items.

The line for efficient utilization of the extrusion technology is intended for making extruded food products. The production line is developed on the basis of the VED-60 and RZ-KED-88 extruders with the 100 and 200 kg/h output mass-produced by the "Arsenal" production association.

#### Production Line Specifications

Footprint, m <sup>2</sup>	150
Power consumption, kW	up to 120
Water rate for cooling, l/h	1,500
Line cost in millions of rubles (for 1991)	1

A multipurpose vertical drilling-milling machine with two tables, numerical control (ChPU) and ASI is intended for performing all types of drilling operations, milling, boring, and thread cutting on blanks from various structural materials. Two fixed working tables are located on a welded rigid bed; they make it possible to machine various blanks in each table or machine long blanks installed on both tables.

#### Machine Tool Specifications

Maximum machined part mass, kg	2 x 600
Working feed (continuous control), mm/min	1-5,000
Main motor drive power, kW	12-15
Number of tools in the magazine, units	2 x 12
Tool positioning accuracy, mm, at the following length:	
300 mm	0.012
400 mm	0.016



The vertical drilling machine on a round column is intended for drilling, boring, countersinking, reaming, recessing, and thread cutting in holes by machine taps. It makes it possible to rotate the table around the round column axis and machine large parts.

#### Machine Tool Specifications

Working surface of the lift table, mm	500 x 630
Maximum drilling diameter in medium hardness steel, mm	50
Thread diameter limit cut in medium hardness steel	M3-M33
Spindle rotation speed limit, min <sup>-1</sup>	31.5-4,000
Spindle feed limit, mm/rev	0.1-1.6
Maximum spindle torque, Nm	400
Main drive motor power, kW	4
Coolant lubricant tank, m <sup>3</sup>	0.022
Machine tool mass, kg	1,400

"POISK" multipurpose expert simulations systems are intended for developing the automation facilities for comprehensive research and optimization of the performance of existing production systems of various types and those under design. The systems make it possible to solve the following problems at a qualitatively new level: to construct a complete information model of the production process equipment plus technology plus production management plus control; simulate the operational dynamics of the process performance under various conditions of their design and organization; carry out comprehensive expert examination of existing production processes and those under design; refine likely concepts for improving and upgrading production and optimum conditions for its design and organization; perform and advance technological preparation of production concurrently with designing production processes (TP); improve the rotating shift planning and interrelations between kindred shops and areas; formulate the requirements for computer-aided process control systems and production control as a whole; develop simulators for training various types of experts; and develop a bank of simulation models and expert systems for various types of production which reflect industry experience and knowledge.

The DPDM small-scale electric motor with a printed disk armature is intended for use within a broad range of dedicated production equipment and consumer goods: in sewing, washing, and ironing machines, coffee grinders, meat grinders, mixers, vacuum cleaners, electric handicap carts, power car windows, windshield wipers, lawn mowers, and fans.

#### Electric Motor Specifications

Power rating, W	90/120
Power supply voltage, V	20/24
Nominal current, A	7.5
Efficiency	0.7
Maximum rotation speed, min <sup>-1</sup>	10,000
Mass, kg	1
Motor dimensions, mm:	
Diameter	147
Length:	
without the shaft	38
with output shaft	63
Output shaft length	8

The KS-1 stone saw machine is intended for sawing and cutting semiprecious and decorative stones. The cutting and cutoff wheels make it possible to perform several operations in one machine tool. The machine tool has a compact design and ensures a high machining quality, automatic cutting process, simplicity, maintenance safety, and economy.

#### Machine Tool Specifications

Maximum diamond wheel diameter, mm:	
Slitting	320
Cutting	125
Spindle rotation speed, min <sup>-1</sup>	2,300 and 3,000
Blank feed to the cutting zone	Manual and automatic
Automatic blank feed speed, mm/min	5
Cut length, mm	160
Cut height, mm	110
Mohs scale cut stone hardness	up to 9
Type of cooling liquid	Water
Power consumption, kW	0.8
Overall dimensions, mm	740 x 430 x 455
Mass, kg	46

A flexible production module for installing surface-mounted elements is intended for automatically placing surface-mounted elements for the electronic products (PM-IET) on the surface of printed boards according to a specified program. The module consists of a bed, a feeder, a terminal-free electronic product installation mechanism, a group gripping device, and the following mechanisms: for moving the boards, fixing them, coordinating their movement, a conveyor, optical indicators, and a distributing device.

**Module Specifications**

Printed board overall dimensions, mm	(90-330) x (80-250) x (1-2)
Output at a 5 mm coordinate displacement step and simultaneous IET gripping and laying, at least, products per hour	6,000
Number of vacuum gripping devices in the group assembly	10
Maximum coordinate installation mechanism displacement speed, at least, mm/s	200
Coordinate displacement error of the installation mechanism, mm/s, no more than	0.05
Distance from the floor to the board transportation plane, mm	950+/-10
Power consumption, kW, no more than	1.6
Overall dimensions, mm	1,410 x 2,215 x 1,970

The VEST-240-4 electric erosion cutout production complex (TK) is intended for computer-aided electric erosion cutting out and finishing polishing of complex shaped surfaces of the basic and tool production parts and automated preparation of control programs for the numerical control devices. This complex makes it possible to machine complex shaped holes with a roughness of up to  $R_a = 0.2 \mu\text{m}$ ; it ensures production of sloping surfaces of up to  $7^\circ$  and making die bells in blanking die matrices with a profile which is equidistant to the working collar profile and automatically prepare control programs directly from the part drawing and enter the control program into the numerical control device of the machine tool. The use of the complex reduces the amount of menial labor by 60% in honing and polishing operations with shaped surfaces in basic and tooling production parts and decreases the labor outlays for making die parts by 40%.

**System Specifications**

Maximum machined blank dimensions, mm	250 x 160 x 80
Maximum displacement coordinates, mm	
x-axis	125
y-axis	200
Machining accuracy, mm	0.02
Maximum output:	
Electric erosion cutting, $\text{mm}^2/\text{min}$	30
Electric erosion polishing, $\text{min}/\text{cm}^2$	30
Overall dimensions, mm	3,524 x 800 x 1,950
Mass, kg	1,500

An ultrasonic hardening unit is used for surface plastic deformation of mechanical engineering parts and is intended for hardening and restoring parts like turbine blades, shafts, gears, plungers, dies, die casting molds, etc. Up to 100 or more parts placed into the working chamber are simultaneously treated on all surfaces. This

makes it possible to increase the labor productivity by severalfold and reach a new quality of surface plastic working operations by eliminating warpage. The UZU-1 unit is equipped with a four-stage automatic power and machining duration control system, a circulating water feed system for cooling, and interlocking devices which operate when maintenance safety conditions are violated; it is convenient for machining parts which are fastened manually inside the working chamber. A single person can service simultaneously several such units.

**Unit Specifications**

Maximum overall dimensions of machined parts, mm	250 x 120 x 50
Maximum machined part mass, kg	50
System capacity, pieces per hour	up to 10,000
Treatment duration of a batch of parts, minutes	0.1-30
Generator output, kW	4
Vibration frequency, kHz	16-20
Machined surface roughness, $\mu\text{m}$	0.16-1.6
Installation mass, kg	620
Footprint, $\text{m}^2$	1.0

The "Turbotekhnika" is offering its HEATEX applications software package which makes it possible to perform the following analyses: supercharger diesel air cooler with optimization of thermal and hydraulic characteristics; fluid and oil radiators; a unit of engine heat exchangers allowing for their effect on each other; and two and three loop diesel power plant cooling systems, as well as the systems of prestarting liquid-cooled diesel heating which involves calculations of transient temperature fields of the cylinder-piston group parts and an analysis of the cooling system fluid heating.

The "Baltiyets" production association in Narva is offering to the exhibit visitors its RRP-4 radioisotope relay device for automatically monitoring and controlling processes in various branches of the industry. The RRP-4 device can perform the following functions: contactless position monitoring of the level of liquid and bulk materials; monitoring the interface of two media; monitoring moving objects and transportation facilities; counting items; monitoring the presence of materials on conveyor belts, in bunkers, and in other process equipment. The device has a dust ignition proof construction and may operate under conditions of explosion hazardous media in various branches of the industry. The BDG-18 detection unit has a sufficiently high explosion safety level.

The operation of the RRP-4 device is based on recording the power drop of the  $\beta$ -radiation exposure dose on the surface of the detection unit when the product attains a given level or position. It has the following technical data: the BDG-18 unit has a  $\beta$ -radiation sensitivity for strontium-90 plus yttrium-90 radionuclides of at least  $3 \times 10^4$  pulse x  $\text{m}^2/\text{particle}$  (3 pulse x  $\text{cm}^2/\text{particle}$ ); the

electric operate threshold is controlled within two sub-ranges: from 20 to 200 pulses per second and from 200 to 2,000 pulses per second; the power demand is no more than 20 W. The device can operate round the clock; its mean service life is at least 6 years. The RRP-4 device consists of the following modules: BOI-3 data processing unit, BDG-18 detection unit, and BBI-30-6 covered radioisotope source.

The "Tekhnologiya" scientific production association is working on comprehensive mechanization in mechanical engineering for the light industry, including production of textile machines as well as consumer goods, such as tubular electric heaters, vacuum cleaners, refrigerators, irons, etc.

The universally selectable devices for assembly and welding (USPS) shown at the fair by the "Tekhnologiya" scientific production association shorten the production tooling time for new products by 3-5 times, increase the assembly and welding operation mechanization by 2-3 times for pilot and small-batch production, and decrease the material and labor outlays by threefold. It is recommended that the USPS be used in pilot and small batch production. The USPS is based on the principle of multiple use of different elements during their entire service life (up to 10 years). The distinguishing feature of the USPS is the availability of assembly fixing units which considerably speed up the assembly of devices. The greatest efficiency is reached in welding framework structures from rolled sections from no. 4 to no. 20 and three-dimensional skeleton structures from rolled angles from no. 2 to no. 5 (with overall dimensions of (300-8,000) x (300-2,000) x 1,200 mm).

The reliability and longevity of USPS parts and assemblies is ensured by selecting proper materials and heat treating them, as well as by the availability of a special coating which ensures the element surface protection from molten metal drops sticking during welding or from attrition during assembly.

The exhibits presented by the scientific production association also included an automatic machine for cutting pipes with a 10-25 mm diameter and up to 2 mm wall thickness. The tubes are cut by a disk due to plastic deformation without producing chips. The cutting cycle is automated.

The "Yadro-1" shortwave radio station ensures simplex radio-telephone communication with direct entry and without fine tuning between mobile objects and with dispatcher stations controlling various production lines. The radio station is designed on a modular principle and consists of a transceiver, an antenna matching device, and a control panel. The radio station belongs to third generation equipment broadly utilizing transistors and integrated circuitry.

The radio station is equipped with a built-in monitoring system which makes it possible to check the serviceability of the radio station and locate the malfunctioning module without using additional testing instrumentation.

Radio Station Specifications	
Frequency band, MHz	2,000-17,999
Tunable in frequency steps, Hz	100
Peak transmitter power, no more than, W	100
Power demand, W, no more than, in:	
Receive	200
Transmit	640
Transceiver overall dimensions, mm	196 x 464 x 252
Mass, no more than, kg	20.5

A device for identifying mobile objects (UIPO) with a dust ignition proof construction and spark proof output circuits on the basis of the UID-1 identification device is developed at the Mining Institute imeni A.A. Skochinski. The UIPO is an external data transducer for systems controlling complex transportation systems and automatic warehouses and makes it possible to identify various mobile objects in order to monitor them, account them, sort them out, and control their motion.

The UIPO operating principle amounts to the following: a small-size self-contained code sender attached to the object being identified radiates a low-power identification signal; the code sender receives electric power supply over a contactless induction channel when it comes close to the reading transducer. The UIPO contains a set of code senders, a reading transducer, and a module for communication with a dedicated remote control system.

The UIPO has the following advantages: a high degree of identification confidence; minimum requirements for the code sender orientation accuracy relative to the reader; stability to the effect of shocks, vibration, and corrosive vapors and liquids; the possibility of interfacing with any remote control system; and small overall dimensions, mass, and power consumption.

UIPO Specifications	
Number of identified objects, at least	65,500
Code sender distance from the reading transducer, no more than, mm	50
Alternating current power supply voltage, V	127
Power demand, mA, no more than	500

The Ryazan automotive equipment plant displayed at the exhibit the 14.4404010 evaporative pressure regulator intended for decreasing the gas pressure in the cylinder to a close to atmospheric pressure at all engine

operating conditions in truck power supply systems as well as for metered gas delivery to the engine in the idling condition.

The evaporative pressure regulator design distinguishes it from similar units by the presence of a sensitivity enhancement system which maintains a stable gas pressure at the pressure regulator output while simultaneously ensuring the engine idling condition.

#### Evaporative Pressure Regulator Specifications

Overall dimensions, mm	130 x 205 x 221
Outside diameter, mm	160
Mass, kg	3.26

A program control device serves for manufacturing various tools (drills, reamers, and taps). Depending on the steel hardness, machining is performed by diamond grinding wheels or grinding wheels from cubic boron nitride.

The microprocessor-based program device defines the pitch, length, and number of helical grooves, the number of tools being made, the machining speed, machining conditions, and diagnostics. The principal advantages of the automatic device are as follows: the mechanical system simplicity, an original design of the tool core thickening mechanism, the possibility of forming to shape and rebuilding grinding wheels on the machine tool spindle, efficient grinding wheel cleaning in the machine tool spindle, heat removal from the cutting zone at a low liquid rate, high output, and the simplicity of retuning the device for various standard sizes of tools being made with a cylindrical and conical shape.

The tool-making program-control device is being offered by the "Ramenskoye Instrument Making Plant" production association.

#### Automatic Device Specifications

Machined drill bit diameter, mm	0.5-3
Maximum machined part diameter (milling cutter, enlarging drills, reamers, taps), mm	6
Maximum machined length, mm	100
Angles, radii	0-90
Helical groove pitch range, mm	1.5-96
Pitch variation step, mm	0.01
Overall dimensions, mm	1,260 x 865 x 1,480
Mass, kg, no more than	1,100

The "Naveks" scientific production implementation company is exhibiting at the fair electronic field delivery and control systems divided into two categories: gas- and liquid-fuel feeders. The actuator control modules are completely standardized.

The gas delivery system serves for ensuring the optimum gas delivery parameters in steady-state and transient engine operating conditions by changing the phase and shape of the control electric pulse applied to the electromagnetic gas valve, and is free of the flaw inherent in all operating systems—an excessive sluggishness which makes the dynamic properties of the gas engine equal to those of its diesel prototype.

Installation of the electrohydraulic liquid fuel delivery system on the motor makes it possible to ensure the motor operating conditions in the framework of stiffening standards governing the discharge of particulates and toxicity, and lower the fuel rate by 10-30%, especially in the partial load range, and up to 70% in the idling condition.

Process optimization is attained by changing the fuel delivery and application phase at each point of the engine performance curve. Generation of the control pulses allowing for all the correcting actions is performed by the interface device.

These systems are being supplied to marine, stationary, and automotive engines, whereby the mass of the control unit and actuating tools is virtually proportionate to the engine power.

The "Temp" plant in Furmanov, Ivanovo oblast, is exhibiting a series of items (a fluid flow rate relay, an evacuation plant, a vacuum valve, the KE-5 valve, etc.).

The fluid flow rate relay is intended for indicating the presence of a given water rate in the draining devices of the hydraulic network and for visual monitoring of the water flow during production of electronics products.

#### Relay Specifications

Overall dimensions, mm	63 x 50 x 180
Mass, kg	0.4
MTBF, cycles	10,000

The relays switch alternating current circuits at a 50 Hz frequency and direct current circuits at a 0.1-36 V voltage and 0.001-0.1 A current.

A ribbon endoscope is an industrial fibroscope with a submersible part executed as a ribbon. The ribbon has a rigid construction in one part while it can be bent in others; it can also be twisted and the distal end can be deflected by a special mechanism. The endoscope is used for monitoring the assemblies and cavities whereby the inspection is performed through peepholes shaped as slots and gaps. It makes it possible to perform inspections in contaminated cavities whereby the submersible part is equipped with an additional tube for protecting the optical surfaces on the distal end by blowing compressed air over them. The hollow metallic shell of the submersible part can be used as a means for delivering round endoscopes and instruments into the observation zone. As a result, the following additional functions are



possible: an elevated stability to mechanical actions; endoscope end blowing for preventing contamination; an increased lighting intensity (from additional sources and optical fibers); and the possibility of using the endoscope in complex labyrinth cavities.

Endoscope Specifications	
Length, mm	up to 1,700
Maximum cross section dimension, mm	2 x 10
Minimum bending radius, mm	100

The ribbon endoscope was developed at the Central Aviation Motor Engineering Institute imeni P.I. Baranov (TsIAM).

The "Impuls" nanosecond pulse curve tracer designed by a branch of the Central Scientific Research Institute "Tsiklon" in Fryazino is intended for diagnosing Gunn diodes, avalanche transit time *p-i-n* and S-diodes and field effect and bipolar transistors by the voltage current (VAKh) input, output, transient, and transfer responses. The curve tracer makes it possible to perform the following functions: take measurements in the nanosecond duration range ensuring production of data about the serviceability and parameters of high-speed devices; study S- and N-shaped voltage current characteristics; take nondestructive measurements of the electrophysical parameters to determine the safe operation ranges; carry out nondestructive testing of devices under currents substantially exceeding the working current in order to predict the reliability potential; and study the stability of devices to pulse overloads.

The curve tracer operating principle amounts to examining sections of characteristics with a negative incremental resistance (ODS) whose parameters correlate with the reliability and quality of devices and determine the safe operating ranges.

The following information-containing parameters are measured: for Gunn diodes, the critical voltage at which ODS is observed; for *p-i-n*-diodes, the critical current and voltage jump in the ODS segment; for the avalanche transit time diodes, it is the overvoltage compared to the operating condition necessary to attain the critical current; for GaAs diodes, it is the value of incremental resistance in the segment preceding ODS. The curve tracer has an output connected to a high-speed sampling oscilloscope and an XY plotter.

The small-size navigation radar (RLS) exhibited at the fair employs a special type of signal as a result of which the principal technical requirements imposed on navigational radars according to the international rules for ensuring navigation safety are satisfied, while simultaneously being environmentally clean and electromagnetically compatible and increasing the operating reliability.

The radar is environmentally clean, i.e., eliminates the harmful effect of microwave (SVCh) radiation on the human body and the environment. This is attained by

sharply decreasing the peak background radiation power to  $25 \mu\text{W}/\text{cm}^2$  at a 5 m distance from the antenna. In similar devices, this figure reaches  $10 \text{ W}/\text{cm}^2$ .

Electromagnetic compatibility—the possibility of noise-free operation with other radio and electronic devices on the ship and noise immunity from signals of operating radio electronic devices—is attained due to the elevated selectivity of the receiving and signal processing devices, and may be characterized by the possibility of joint operation of several hundred radars located in a water area covering one square mile. In similar devices, joint operation of two like radars under such conditions cannot be ensured without interference.

The increased operational reliability of these radars is attained by completely eliminating the high-potential devices and sealing the units, and is characterized by an MTBF of 1,000 operating hours.

The radar being exhibited by the "Granit" central scientific research institute is intended for installation on seagoing ships for various purposes displacing 20-1,600 tons. The radar is executed as modules: an antenna device with a transceiver, a signal processing device, a converter, and an indicator device with a control panel. All modules have a splash-proof design and natural cooling. The antenna device together with the transceiver contain a slot antenna with a rotation drive using a low-voltage low-speed motor. The transceiver is housed inside the rotation drive and consists of a number of modules executed using microelectronics technology, and is airtight.

The signal processing device consists of a number of modules which contain boards with two-sided printed wiring located on a heat sink, which is the basis of this construction. The station receives power supply from a 220 V 50 Hz alternating current power main.

The indicating device with the control panel are a TV-type cathode ray tube with a 31 cm diagonal dimension with a green screen background.

Numerous exhibits shown at the fair included a two-screw mixing-welding extruder for making semifinished products, food concentrates, and end products produced with the help of a brief high-temperature process under high pressures. The extruder can be used in bakery, starch and molasses, food concentrate, dairy canning, and other branches of the food industry. It combines several process operations: mixing, curing, molding, and cutting the product, which ensures process continuity and shortens the product preparation time. The use of induction heating makes it possible within a short time to bring the installation to the necessary condition, thus ensuring maintenance and service simplicity. Furthermore, induction heating makes it possible to increase the temperature in the extruder housing to 300-400°C, making it possible to burn the product while "welding up" the extruder. The developers maintain that this type of heating is the most economical.

Two auger shafts located near each other which are made from screw elements with various pitch and length fitted onto the shaft rotate in the same direction and are placed in a housing which has a figure-8 cross section. Unidirectional screw rotation considerably decreases the friction forces, which lead to rapid auger wear. Any switching of the screw elements relative to each other substantially affects the resulting product. The unit design makes it possible to gain easy access to the screws for their repair, cleaning, and sanitary processing. They are installed using a kit of attachments, spare parts, and replacement parts. The control panel box is equipped with a mimic panel of the unit.

### **Fundamentally New Technologies for the Production of Ceramic Brick**

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[Article by Ye. V. Zalizovskiy, candidate of technical sciences, UralNIStromproyekt (Urals Scientific Research and Design Institute for Construction Materials); UDC 691.4.666.712.002.2]

[Text] UralNIStromproyekt has developed a succession of new generation heating units for drying and firing ceramic building materials.

The basic design element of these units is an annular rotary furnace with hydraulic seals and a flexible-coupling drive which provides practically any type of drying and firing with minimal energy consumption.

The first similar furnace, in which bricks are fired in stacks, was developed in 1983. The productivity of the furnace under a 36-hour firing cycle is effectively 26 million standard units of brick per year. Ideally, the furnace is divided into 24 zones. Rotation of the hearth is achieved cyclically at an angle of 15° by means of two radially positioned flexible-coupling drives with a power rating of 22 kW.

This unit is intended as a replacement for outdated furnaces in the operational lines of the technology. The main prototype of the furnace design is currently under construction in the republic of Mari El.

The marked tendency in recent years toward implementation of high-speed, heavily mechanized technologies has pin-pointed the need to develop a universal firing unit—a rotary, dual-chamber furnace/drying kiln, which serves as the basis for the development of an automated, modular, rotary conveyer line for the production of high-quality construction brick.

The complex facility named "ARKL-kirpich [ARKL-brick]" solves the problems associated with the development of fundamentally new domestic equipment and technology needed to provide higher labor productivity, shorter technical processing periods in the manufacture of brick along with reduced expenditure of energy and

materials, and increased equipment reliability. New equipment and technology also ensure the creation of fully automated technological modules which provide for the formation of enterprises of various capacities ranging from 10-15 million, and up to 40 million standard units per year.

The proposed "ARKL-kirpich" experimental industrial facility consists of the following:

a section for stockpiling raw materials and preparation of the furnace charge, with potential for the production of 40 million standard units of brick per year (when production is expanded through construction of three modules); with a single module operating, which provides production of 13 million standard units per year, the charge preparation section works one shift, while three modules in operation requires two shifts;

a molding section and packing section operating in three shifts;

a drying-firing section operating in three shifts;

a warehouse for storing the finished product in three shifts, and shipping the product in two shifts.

Delivery is accomplished by motor transport.

The facility's operational cycle with regard to technological processing is as follows.

Clay is fed into an SMK-225 clay-grinder [SMK=construction-assembly crane] by an SMK-214 hopper. After passing through an iron-separator, the ground clay travels by conveyer belt to an SMK-194A stone-removing roller mechanism.

A receiving bin with a feeder is set up for preparation of the charged load with various types of admixtures. Following initial processing and removal of contaminants, the load moves on to greater refinement in an MS-11 disperser.

The MS-11 disperser is a fundamentally new unit, in which the ceramic load is carefully pulverized using a spinning rotor down to fractions measuring no more than one millimeter, and, when necessary, it is moistened. The use of this new unit makes it possible to completely exclude calcareous contaminants.

Following refinement in the disperser, the charge is sent out for storage in a service bin fed by an SMK-351 apron conveyer.

The bin is designed to hold an amount of charge corresponding to an adequate reserve for two shifts, which ensures uninterrupted operation of the molding section during the second and third shifts.

Control of all the equipment concerned with receipt of raw material, and preparation and release of the charge from storage is managed by remote control from the operator's control panel.

On a system of conveyer belts, the charge proceeds from the service bins to electric heating of the ceramic load in a facility which is another fundamentally new apparatus.

This electrical unit (productive capacity—30 tons per hour), in contrast to a steam heating unit, achieves volumetric heating of the ceramic load without additional wetting, and, as a result of the prompt volumetric heating, it enables further disintegration of the load, as well as improvement in its molding characteristics. Costs for heating of ceramic loads in this apparatus are one and a half to two times lower by comparison with a steam heater.

After heating to 45-50°C, the ceramic load goes to a rotary vacuum press for molding of the raw brick material.

The rotary press—also a new development—provides volumetric molding and pressing of blocks with pressures at the head-end of the press of 3-4 MPa.

The use of this press facilitates the formation of hardened loads, provides a nondefective (unrippled) structure through the brick cross-section, and reduces energy consumption owing to the changeover from the extrusion method to volumetric molding.

After it is pressed, each clay block is cut into bars in an automatic cutting machine, and then into 30 bricks by an automatic cross-frame cutter using an automatic interchange of cutting wires. Trimmings and spoilage from the molding process are returned to the rotary press by the conveyer system.

In order to ensure continuous operation of the molding section and the rotary drying oven, the technological scheme calls for the installation of two rotary presses with a redundant system of automatic cutters.

The row of 30 identical bricks formed in the automatic cutter are then fed by an automatic stacker into the drying chamber of the rotary furnace. The brick is placed on the moving hearth on its "header [narrow end]" as stipulated. The dried brick (a row of 30 units) is radially transferred by an automatic re-stacker from the drying chamber to the firing chamber. After firing, the line of bricks is moved by an automatic unloader from the firing chamber, and is delivered to an automatic packing device.

The new automatic packer stacks the fired brick on standard pallets. Empty pallets are delivered to the autopacker, and loaded pallets to the warehouse by an electric loading mechanism. During the phase of the process from the reserve storage bins to the packing of brick, these automated mechanisms are remotely controlled by an operator from a central console.

The rotary furnace/dryer contains two concentric chambers mounted on a single moveable hearth. Each of the chambers (firing and drying) has its own individual venting system. The furnace vent is outside the annulus, while the drying chamber vent is inside the annulus.

The furnace chamber is nominally divided into three zones in terms of temperature range: the preheating zone, the firing zone, and the cooling zone. The preheating zone is equipped with two recirculating systems for temperature range compensation and removal of depleted coolant.

The firing zone is equipped with a set of low-pressure burners mounted in the roof panels, and two fanning ventilators which supply air to the burners. The cooling zone makes use of outside air, which, after heating, is fed into the heat-supply system of the drying chamber.

The drying chamber is nominally divided into three zones in terms of current-flow of the heat-transfer medium. Each of these zones consists of two equal-size subzones: counterflow and straight-flow. All of these sections are equipped with their own individual systems, which consist of a plenum chamber and a forced-air ventilator, for generating and supplying heat-transfer media.

Hot air from the cooling zone of the furnace mixed with outside air and recirculated air is used as the heat-transfer medium.

Burners are installed in the plenum chamber to adjust the temperature of the fresh heat-transfer medium. Three sites are provided for exhaustion of the depleted heat-transfer medium, part of which is released into the atmosphere, while part is used as recirculant.

The drying-firing process is automatically controlled using microprocessor technology, and the data for controlling the operational parameters is mainly resident in the central console.

The rotary furnace-dryer has the following advantages over traditional designs of similar application:

- it provides a high degree of stability to the thermal and aerodynamic regime of the drying and firing process;

- the use of the recently developed technique of direct-flow/counterflow, multi-zone input and output of heat permits intensive drying in the drying chamber with minimal heat expenditure (1000-1100 kcal/kg of evaporable moisture);

- the zonal arrangement of burner devices in the firing chamber, in combination with an aerodynamic design permits high-speed firing of products;

- combination of the drying and firing processes in a single unit optimizes its thermal power cost-effectiveness;

- an original engineering solution, incorporating the use of a common rotating hearth for both the drying and the

firing chambers, simplifies the system for repositioning finished materials, while the use of a symmetrical cable drive eliminates radial forces, increases the reliability and rotational stability of the hearth, and permits variable-speed rotation which regulates the operational processes; the high-security fettling of the firing chamber roof increases its useful life.

The furnace hearth is lined with plates made from firebrick fiber, which are inlaid as in a metalworking hearth. The constituent elements of this refractory lining are manufactured from heat-resistant concrete in grog aggregate and high-alumina cement.

The upper portion of the lining contains a channelized lamina made from heat-resistant concrete in a firebrick-alkali binder. This laminated refractory lining provides the thermal-insulation reliability which is needed for metalworking, and it allows maintenance of exterior surface temperatures at no more than 45°C.

Using the rotary design makes it feasible to concentrate the loading of raw materials and unloading of finished products at a single site, thereby enhancing the technical efficiency of this process.

The loading/unloading window and the movement of the furnace hearth at a moderate speed (no more than 3 mm/sec.) are features which permit high-speed fettling operations on the channelized lamina without stopping the rotation of the rotor.

The innovative design of the moving hearth, which is made up of separate modular sections, and which rides on roller bearings, makes it possible to replace the rollers using specially articulated devices without stopping the hearth.

Both of the rotor chambers are equipped with concentric regulated hydraulic pressure valves which ensure hermetic sealing of the chambers.

The structural design of the furnace makes use of modular elements. The primary structural components are the lightweight support panels of the furnace chamber roof, and the interior support walls spanning the length and breadth of the furnace perimeter. Firebrick-fiber plates are used as the materials for these structures. The structural design of the drying chamber calls for thermally insulated modular metal compartments.

The use of modular support structures which are supported by the basic framework of the unit makes for a high level of overall ease of assembly.

Implementation of this technologically advanced line facilitates retirement of the inventory of furnace and dryer carrier-cars, along with their means and mechanisms of transport, which creates a considerable advantage over all of the usual thermal appliances for drying and firing of brick.

The following technical and economic indicators were derived from an analysis of the design.

#### Technical Specifications for the Innovative ARKL-KIRPICH Equipment

Rotary Furnace-Dryer		
Annual productivity in millions of standard units of brick		13
Dimensions of drying and firing chambers, mm:		
width		334
height		290
Number of rows in terms of height		1
Number of bricks per radial row in drying and firing chambers, units		30
One-time capacity of one chamber, units		11,911
Duration, hours:		
drying		8
firing		8
Firing temperature, °C		1000
Temperature of heat-transfer medium in drying chamber, °C:		
in section I		47
in section II		57
in section III		119
Temperature of heat-transfer medium at dryer vent, °C		43
Temperature of exhaust gases at furnace vent, °C		100
Rotary Disperser		
Productivity, tons per hour		up to 50
Installed capacity, kW		130
Grinding dispersity, mm		1-2
Load, kg		5720
Apparatus For Electric Heating of the Load		
Productivity, tons per hour		30
Installed capacity, kW		135
Power consumption, kWh per 1000 standard units of brick		70
Load, kg		4500
Rotary Press		
Productivity, m <sup>3</sup> /h		5
Installed capacity, kW		71
Power consumption, kWh		25
Load, kg		4815
Automatic Packing Machine		
Productivity, units per hour		2400
Installed capacity, kW		17.9
Power consumption, kWh		14.3
Load, kg		7600
Technical and Economic Indicators (1984 prices)		



### Technical Specifications for the Innovative ARKL-KIRPICH Equipment

	1 Module	3 Modules
Annual output, in crude terms, millions of units	13	40
Estimated cost, production engineering, thousands of rubles	3769	9824
civil engineering work included in the above figures	2583	6951
Specific capital investment, per 1000 s.u. brick, rubles	290	245.6
Return on investment, rubles	0.33	0.4
Production costs, 1000 units of brick, rubles	57.15	50.15
Production cost per ruble of commercial output, kopecks	60	53
Production profitability, percent	12.7	18.1
Annual profit, thousands of rubles	485.9	1775
Return on capital investment period, years	7.8	5.4
Work force, personnel	45	97
labor force included in the above numbers	39	90
primary production workers included in the above numbers	11	25
Productivity, thousands of units:		
per worker	289	412
per primary production worker	1182	1600
Specific outlay of energy resources for technological needs:		
electric power for entire technology, kWh/1000 units of brick	259	256
factoring in drying and firing unit, including electric heating, kWh/1000 units of brick	153.5	153
fuel, kg standard fuel/1000 units of brick	190	190

Analysis of the technical and economic indicators revealed that the ARKL-kirpich technology is on a level with worldwide equivalents, and it in fact surpasses them in a number of indicators.

Construction of the first two technological lines will be completed this year in the city of Chelyabinsk in Yuzhno-Uralsk.

This year will also see completion of construction on the first experimental environmentally-safe rotary unit for drying and firing brick using microwave energy. This is a system having a productive capacity of a million standard units of brick, in which drying of a 25-30%-hollow brick with an initial moisture content of 14-16% is achieved within 1.5-2 hours, and firing, including the cooling cycle, within four hours. Moreover, the heat expenditure during drying and firing, according to preliminary data, equates to 135-140 kg of standard fuel per 1000 units of brick. The unit has two circular chambers: the drying chamber is 700 mm wide, and 160 mm high, with an average diameter of 4000 mm; the firing chamber is 700 mm wide, and 280 mm high, with an average diameter of 8000 mm. The rotor is turned by a 2 PB 100 MGUCH [expansion not given] electric motor with a power rating of 0.6 kW. Total power capacity of the microwave generator is 75 kW.

[Advertisement on page 15]

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